Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, NOVEMBER 11, 1905. No. 20.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....1139 Monadnock Block
PHILADELPHIA OFFICE.....929 Chestnut Street
CLEVELAND OFFICE.....402 Cuyahoga Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....Per year, $3.00
Foreign Countries, within the Postal Union.....$6.00
Great Britain and Ireland.....25 shillings
Germany.....25 marks
France.....31 francs
Single copies.....10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

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Entered as second-class mail matter at the New York Post Office.

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Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **620,000.**

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AMERICAN PATENTS IN GERMANY.

A most important article appears in our pages this week dealing with the treatment of American inventors as patentees in Germany. It is needless to tell most of our readers that for several years past there has been a good deal of hard feeling in the United States as to the manner in which the Imperial Patent Office is alleged to have made the path of the American inventor a difficult one. We have ourselves heard bitter complaints on the subject of alleged unfairness, and we have understood that the feeling of bitterness was general. But no one seemed to have an explanation or a remedy.

We are very glad to be able now to lay before our readers the official statement on the subject of no less a personage than President Hauss, of the Imperial Patent Office. This authority has taken considerable pains and trouble to present the attitude and actions of the German officials in what he considers to be the fair and proper light, and even if his letter were nothing else, it would have great value as an exposition of the methods and modus operandi of his department. It is more than that, however; it is a plea for better, helpful understanding on both sides. We commend this statement of President Hauss to the thoughtful study of our readers, in the hope that it may tend to closer co-operation, and to friendship where distrust existed. If, as President Hauss asserts, American inventors are themselves largely to blame, it is time they knew it and acted accordingly.

THE SWEDISH ELECTRIC RAILWAY EXPERIMENTS.

We have, from time to time, made reference to the slowly developing plan for the "electrification" of the Swedish Government Railroads, and this week we are able to present the preliminary report of Mr. Dahlander, chief engineer of the Railroad Administration, upon the preparations made for experimental work with single-phase locomotives and motor cars. It is an elaborate programme and one which if followed out will lead to the collection of important data on this type of apparatus. The controlling reason for limiting the present experiments to the single-phase system seems to have been the supposed greater facility of speed control than in the case of induction motors, a factor of larger importance in the case of general railroading with much freight and local service than in interurban or similar work. It was also believed that higher voltage could be used on a single-phase trolley line than would be permissible with a polyphase construction. In view of the Zossen work one may be permitted to discount this hypothesis somewhat. However it is just now very timely to try out single-phase locomotives, since their working properties are as yet very imperfectly known, and if satisfactory imply great developments in electric railroading. Some five or six miles of track are being equipped, and two locomotives, one from the British Westinghouse Co. and the other from Siemens-Schuckert Co., will be put through thorough tests. The experimental power station allows variation of frequency from 15 to 25 cycles and of voltage from 3,000 to 20,000, so that it should be possible to cover the working range of conditions very thoroughly.

There appears to be nothing out of the ordinary in the plans for the locomotives, save that in the Siemens-Shuckert locomotives the motors are provided with separate artificial cooling which ought

to produce a good effect as it has in the few cases in which it has been tried. It will certainly prove interesting, however, if the output of these single-phase motors turns out to be limited by the heating rather than by the commutation. The programme for experiments is a very elaborate one and should give a vast amount of valuable data when completed. It is exactly what is needed in case of a strikingly new system, and it is what we have very little chance of getting in this country. Here, whenever a revolutionary novelty appears, of whatever kind, it is likely to be put into service through the courtesy of various financial interests, and it is only after the outsiders have been permitted to break in and acquire some experience that one gets a fair perspective view of the situation. It is doubtless wise policy thus to be cautious in putting out new devices, great or small, but for the engineer desirous of getting to the bottom of the matter it is sometimes a bit wearisome. When Mr. Dahlander brings in his report we shall be anxious to see it and shall lose no time in presenting it to our readers. The Swedish railway proposition is a most striking one since it involves a very wide variety of service in a country where the density of traffic is relatively small. Experience gained upon it will be far more illuminating than any to be acquired in more densely populated regions, and for that reason will be of more significance as applied to American railroading. Our problem in this country is not how to equip suburban service or fast interurban lines, for this experience we have already acquired, but how to deal economically with mixed service on long lines, how to plan a system generally useful in the same way that steam locomotives are generally applicable. The single-phase scheme gives promise along these broad lines and the sooner it is thoroughly tried out the better.

Residual E. M. F. in the Carbon Arc.

A vast amount of literature and discussion have been devoted to the question as to whether there is or is not a counter electromotive force in the ordinary carbon arc lamp. There is certainly a difference of potential presented between the carbons during the operation of the lamp on a direct-current circuit. This difference of potential may be from thirty to two hundred volts, according to the conditions of the case. Whereas some have maintained that this difference of potential was to be attributed to a c.e.m.f. in the arc, others have asserted that the arc is devoid of c.e.m.f. and that it possesses only ohmic resistance. Of late years the latter theory has prevailed, and it is now generally believed that the column of incandescent carbon vapor forming the arc possesses a definite amount of resistance. The flow of current through this resistance establishes the observed difference of potential. A paper read before the American Physical Society this year by Mr. G. G. Becknell tends to show that there is a definite small c.e.m.f. in the carbon arc of less than two-thirds of one volt. This c.e.m.f. is found to persist after the removal of the exciting current through the arc. This is certainly definite evidence as to the existence of a real c.e.m.f. The persistence is not for a mere shadow of time, but in dwindling magnitude is found to endure for five or ten seconds. The theory of the phenomenon is not clear; but it appears to be associated with the high temperature of the carbon tips, and perhaps also with the difference in temperature between them. It is found from oscillographs taken of the pressure and current at the carbon terminals of arc lamps supplied by alternating currents, that the current and voltage reverse synchronously; or that there is no appreciable residual c.e.m.f. to displace the phases of e.m.f. and current. A c.e.m.f. of half a volt might, however, readily escape detection. The general conclusions are, therefore, that the potential difference at arc-light carbons are attributable to a drop of pressure in a real resistance offered by the glowing carbon vapor. At the same time there may be a thermo-electric c.e.m.f. of less than one volt, the exact nature of which is somewhat obscure. It is to be hoped that experimenters will follow this matter up in the future.

The Nature of Lightning.

The three Institute papers on lightning protection, on which we comment below, serve to point the moral which we have drawn at divers times regarding the need of knowing more about lightning prior to trying to avert it upon scientific principles. It is clear enough from the papers that the lightning under consideration was a very variable thing, and that ways and means of circumventing it must likewise be variable. For example, the excellent results from horn arresters on the Shawinigan Falls line show clearly that under the circumstances found there the minor disturbances often grouped as static, cut little figure from the operative standpoint, and that the important thing was real lightning actually striking the system. On the other hand, Mr. Torchio's description of the precautions on station lines showed plainly a system of protection directed mainly against static and induced discharges. In order to attack the problem of lightning protection with some chance of success the nature of the phenomena needs to be studied exhaustively. We know in an approximate way that lightning is of the general nature of a condenser discharge between cloud and earth or between cloud and cloud. For a long time this by a false analogy led to the conclusion that lightning is, therefore, essentially a high frequency oscillatory discharge. But it is clear that the nature of the actual discharge depends on the amount of capacity concerned and on the resistance and reactance of the path. It is easy to see that these factors may assume values leading to so great damping that the discharge would be nearly or quite non-oscillatory, and even if it were oscillatory the capacity involved would probably correspond to very low frequency.

Some recent experiments by Herr Schmidt reported in the *Elektrotechnische Zeitschrift* throw considerable light upon the subject. Herr Schmidt prepared a little rotating disc bearing a white cross spun by clockwork at 50 or 60 revolutions per second and watched it when illuminated by lightning flashes. He found that a "flash" might mean anything from a single discharge lasting no more than 25 or 30 microseconds to a diffuse form lasting perhaps one or even two hundred times as long, while sometimes there would be a volley of several flashes each, very brief and separated by intervals of perhaps 1,000 microseconds. Whether these were unidirectional or oscillatory could not be determined, but the indications point to the former condition. Nevertheless, in the shorter discharges there well may be many a pitch of wave front corresponding to an enormously high frequency, even in a discharge itself a single unidirectional impulse. To account for the observed energy effects there must sometimes be an enormous impulsive current capable of tremendous inductive effects. On the other hand, it is probably true that the diffuse discharges observed by Herr Schmidt may have had wave fronts of very moderate abruptness, although perhaps none the less dangerous. A cloud is not comparable to a metallic sheet as a condenser. Relatively speaking, it is a poor conductor, perhaps even an aggregation of conductors discharging very irregularly. For this reason discharges of lightning may vary enormously in character. In any event in line protection one is dealing not with the flash as a whole, but with say the last one per cent of the path. It is then, a wonder, that purely protective measures have any value at all, let alone a value worth considering, and it would seem wiser policy to direct attention toward keeping the lightning from reaching vital points of the system,

which is the real function of the so-called lightning arresters. Compared with a genuine lightning stroke all ordinary disturbances on the lines seem, and are, trivial and little to be feared.

LIGHTNING AND LIGHTNING PROTECTION.

The three papers on lightning arresters read before the last meeting of the American Institute of Electrical Engineers proved as interesting in regard to the discussion which they evoked, as in regard to the matter contained in the papers themselves. Ever since electrical engineers first erected wires on pole lines, some seventy years ago, troubles have been experienced from lighting. It was soon recognized that these troubles were not all attributable to direct lightning discharges, but that very many were secondary consequences of lightning discharges; the latter setting up sudden induced disturbances was always of high potential and of sudden impulse. The lightning discharges are probably non-oscillatory, but the induced disturbances are liable to be oscillatory. The range of electric energy, potential and current in lightning disturbances is enormously great, and this has constituted one of the great difficulties in supplying adequate protection. There is all the range between the lightining flash which enters an electric station along a line wire, perhaps blowing out a sidewall, or wrecking a chimney, with the violence of the explosion of a ten-inch ordnance shell, and the relatively feeble secondary oscillation which produces a little jump-spark in a coil of wire and burns the insulating coating of the same at some small spot. It is almost impossible to find a practicable and simple lightning arrester which will fully protect the apparatus and station in both of these extreme cases. Thus it happens that an arrester which will do its duty effectively under mild conditions, fails completely when a thunderbolt is aimed at the station. Similarly, it is easy to understand that there may be wide differences of experience and opinion as to the value of an arrester, since lightning disturbances are fortunately not of everyday occurrence, and the particular doses of the trouble which fall to one observer's lot can never be identical with those witnessed by another.

In the days prior to electric lightning, when telegraph lines were the only overhead electric conductors, the damage by lightning was limited to the smashing of poles or insulators out of doors, and to the injury to telegraph instruments within the stations. Lightning arresters came to be part of the regular telegraph equipment, and for the great majority of the disturbances encountered, these lightning arresters were found to give sufficient indoor protection. The arresters were fuse-wires, choking-coils, spark-gaps in air or vacuum tube, and opposed corrugated plates of metal. For out-of-door work, the poles were protected by ground wires, which practically limited the lightning damage to the insulators. As, however, electric light and power wires came into use overhead, the same troubles presented themselves as in the telegraph circuits, but complicated by the fact that the dynamo currents were prone to follow in the path opened by the static discharge. Moreover, the damage done to apparatus in the stations was apt to be far more costly to repair than in the case of telegraphic instruments, owing to the size and cost of the dynamo electric machinery. The result was that lightning arresters on lighting and power circuits necessarily developed along the methods for blocking the dynamo current. The higher the electromotive forces employed in the circuits, the more difficult becomes the task of opening a path to extra high potentials due to lightning, and yet closing that path to the sequence of the dynamo currents. Moreover, in the modern high-tension transmission system, the rise of potential due to the sudden rupture of a short-circuit may be similar in character to that produced inductively by lightning, and these surge potentials must be allowed to splash over the lightning arresters, although the dynamo current must not follow, lest the destructive energy expended in the arrester by the dynamo current exceed that to be anticipated from lightning, not to speak of the interruption of service in the system due to the short-circuit. For these reasons, the ordinary lightning-arrester is rather more properly to be regarded as a dynamo-current arrester.

The factor of safety in the insulation of a tansmission system necessarily becomes less and less, the higher the pressure employed, because our knowledge of the science and art of making insulators and providing insulation has not kept pace with the advance in working voltages. Hence the arresters on high-tension lines have to be installed for continually reducing margins. At a working pressure of thirty kilovolts, the arresters need not open under less than sixty kilovolts, or one hundred per cent rise. But at a working pressure of sixty kilovolts it becomes desirable that the arresters should splash over at ninety kilovolts or fifty per cent excess. In fact, one of the papers read described the installation of arresters for a 50-kilovolt line, arranged to splash over at about 65 kilovolts, or 30 per cent excess, on the basis of virtual voltages. As an extra precaution, however, horn arresters of simple bent copper rod were later installed to work at 90 kilovolts, or to come to the assistance of the earlier installation in case the virtual potential should rise 80 per cent above normal. The results set forth in the two papers on American systems show that several hundred miles of high-tension lines have been operated for more than one year without any breakdown of machinery due to lightning troubles. This, at least, is a satisfactory record. When we remember that, according to the most recent statistics of the Weather Bureau, lightning in the United States is annually responsible for the loss of five hundred lives of persons and of four thousand head of live-stock, three thousand fires in buildings and six thousand injuries to buildings, it is hardly to be expected that electrical transmission lines can be operated without any lightning troubles, no matter how good the arresters employed may be.

Much discussion was elicited as to the value of suspended grounded wires over the working wires. Here again is an expedient which has been tried many times and with the most contradictory reports. It is universally agreed that if all transmission wires were buried in the earth—that is, placed underground, so that there were no parts of the circuit overhead—there would be complete protection from lightning either from direct stroke, or from induced discharge. Nevertheless, we should still be open to trouble from surges, and lightning arresters might still be necessary to protect the circuits from the overflow of potential due to accidental oscillations. The only full protection from lightning disturbance possible for overhead wires, in the sense of similarly preventing the lightning disturbance, would be by carrying the earth over the wires in the form of a grounded metallic cylinder, or of a grounded metallic cylindrical cage of wire. This, of course, is not a practicable plan. Nevertheless, one or more grounded wires carried parallel to a working transmission line, in so far as they form imaginary elements of a completely enveloping wire cage, contribute in some degree to screening the working wires from atmospheric electric disturbances. The only question is as to the degree of protection thus afforded, and to the cost or other disadvantages of erecting such grounded wires. The higher the working potential of the line, the further away the grounded wires must be supported and the lesser the screening influence that any single such wire can afford. It seems, therefore, very doubtful whether it is practicable to give adequate screening to a high-tension transmission line in this manner.

Differential Gas Rates.

Almost invariably when the subject of differential electrical rates come up for discussion, the objection is advanced that much difficulty is involved in the introduction of such rates in the face of gas competition, owing to the existing uniform rate system of charging for gas. At the recent St. Louis meeting of the American Gas Light Association the fact was brought out prominently that the present uniform system of gas rates is far from satisfactory, and that the differential principle developed in the central station field is attracting the attention and interest of gas companies.

In his presidential address, Mr. E. G. Cowdery said that in serving some classes of customers there was no profit, and care should, therefore, be exercised to keep these upon a basis of paying their own way and not be dependent upon the large consumer to make good the deficiency caused by the small one.

One of the papers read at the meeting related to this subject, the author being Mr. F. E. Forstall. Mr. Forstall said that his paper is the fourth which has been read before the association on the subject, and he gave a résumé of the three others. The first paper referred to was by Mr. Walton Clark and was read as far back as 1891. In this paper it was held inequitable to collect upon the investment necessary to the service of one customer, an interest greater or less than is paid by any other customer upon the investment made in his behalf, as was necessarily done when the charge for gas was simply uniform price per thousand cubic feet. A system of charging was advocated whereby the rate per thousand cubic feet should be an amount covering the proportion of the items of expense and interest common to the performance of the total service; and the addition to each bill of the items peculiar to the individual service. The second paper referred to was presented by Mr. Forstall in 1898 and maintained the broad principle advocated by Mr. Clark. The third paper was read by Mr. F. W. Frueauff at last year's meeting of the association, and advocated that the H. L. Doherty differential rate system of charging for electric current should also be applied to charging for gas.

The present paper by Mr. Forstall goes into the subject in considerable detail, giving figures to show the inequity of charging large gas consumers on the same basis as small consumers. In concluding the paper the author says he believes firmly in justice, and therefore in the policy, of a method of charging for gas that will make each consumer pay his share and no more or less than his share of the expenses and the profits of the gas company serving him, and expresses the hope of seeing the end of the present method of charging, under which from 20 to 25 per cent of consumers are served with actual loss to the company, an additional 35 to 40 per cent do not return their fair share of the profit, while from 35 to 45 per cent return an excessive profit.

New York Lighting Commission.

The New York State Commission of Gas and Electricity has given out data as to the work it has done since it began business August 22. Complaints have been made to the commission as to the price of gas in New York City and the preliminary steps looking to a full investigation of the whole subject are now being taken. Syracuse is contemplating a similar step. Approval of the Auburn company's application has been given as below, in accordance with the evidence before the commission.

Since August the commission has transacted business as follows: Approval of bond issues, Light & Power Company, Newark, $40,000; Phoenix Fuel, Light & Water Company, Phoenix, $100,000; Brooklyn Borough Gas Company, Brooklyn, $615,000. Approved of incorporation: Hermon (St. Lawrence County) Electric Light Company, $15,000; approved of stock issue, Auburn Gaslight Company, increase from $500,000 to $600,000; approved of transfer of franchise, Citizens' Light & Power Company, Auburn, to Auburn Gaslight Company.

Rules of practice have been adopted by the commission. Each lighting corporation of the State is required to submit to the State Commission an annual report for the year ending June 30.

The rule in relation to complaints provides that all complaints shall be in writing and the causes of the complaint shall be stated clearly and correctly. Four copies should accompany the original. Within 10 days an answer is expected from the company against which the complaint is directed, and if the answer is not satisfactory a hearing may be ordered.

The general superintendent or manager of every gas and electric light or power company or the person in charge of the business of the individual must inform the commission of any accident resulting in the loss of life or injury to persons, immediately after its occurrence.

Incandescent Lamp Litigation.

The United States Circuit Court sitting at Trenton, N. J., rendered last week a decision denying an application of the General Electric Company for an order of contempt of court against James McLaren, of Newark, N. J., for violation of an injunction prohibiting the defendant from employing in the manufacture of incandescent lamps the process of patent No. 726,293, granted April 28, 1903, to John W. Howell on an application filed November 9, 1897.

The patent in suit is on a method of pumping the air from a lamp bulb, closing the connection between the pump and bulb without the aid of heat, volatilizing a chemical in connection with the bulb to absorb the remaining gases, and then sealing the bulb. An injunction had been served on the defendant on January 13, 1905, following a decree *pro confesso* entered December 10, 1904, declaring infringement by the defendant of the patent in suit. The defendant in his answer in the present case explicitly denied that he had disobeyed in any respect the mandate of the court, or had exhausted or is now exhausting lamps under the complainant's patented process. The court denied the order adjudging contempt and criticized the character of testimony offered against the defendant.

The complainant based its applications for an order of contempt of court upon the testimony of four persons, Albert R. Page, Mary Kenny, Arthur E. Little and Bertha Sincock. Reviewing the testimony, the court said that the witness, Sincock, was only in the employment of the defendant some time in the summer of 1904. Page, after working for the defendant for nearly six months, left his employ, he swears, on the day after the injunction was served, but four witnesses for the defendant say that it was on the same day. Page testified in one affidavit that changes were made in the apparatus by the defendant on the very day the injunction was served simply as an attempt on his part to obtain benefits of exhausting lamps through the use of the complainant's process and avoiding, if possible, the injunction served upon him, but in another affidavit said: "Possibly this change (in the apparatus) was not made for the purpose of avoiding, or in the attempt to evade, the effect of the injunction, but that was the understanding obtained at the time the change was made." The court held that Page left the defendant's employ on the day when the injunction was served and not on the day after, as Page testified.

In regard to the principal witness, Mary Kenny, the court stated that she was an employee just prior to her entering the defendant's service, that she entered it at the instance of the complainant and in his interest, and that her testimony is contradicted by several witnesses on material points. The other witness for the complainant, Arthur D. Little, an expert, assumed that the affidavits of Page, Kenny and Sincock set forth the process of exhausting lamps used by the defendant, and according to which the process described is that of the complainant and was infringed. The court held that the opinion of this witness so far as it is based upon affidavits of the witnesses, Page and Sincock, is without foundation, as they both describe the process in use by the defendant prior to the service of the writ; the only real basis for the expert's opinion rests upon the disclosures made by affidavits of the witness, Kenny, and the court held that it was unsafe to rest the case upon her sole affidavit.

Who Turned Out the Lights?

It is stated that the town council of Levis, Quebec, had a long sitting one night recently to decide whether the town should have an electric or a steam plant for the water works. During the discussion of the subject the electric lights suddenly went out, leaving the council for some time in darkness. That settled the question. The council decided upon a steam plant and gave the contract for it.

American Inventors in the German Patent Office.

One of the vexed and burning questions with American inventors, as many of those in the electrical field are aware, is the alleged difficulty of securing fair and even proper treatment at the hands of the Imperial Patent Office, when taking out patents in Germany. So far as we know, up to this time no explanation of apparent injustices has been forthcoming and so the situation has slowly drifted into one of bitterness and estrangement, and American inventors have said that it was useless to try to get decent consideration in the German Empire. This belief has seriously affected the efforts of American inventors and capitalists in pushing into the German market, and has undoubtedly done great harm in provoking ill-will between two great countries that have so much in common, and so many good reasons for being close friends.

Dr. Alfred Müller, a well-known solicitor of foreign patents in New York City, and an expert in German patent law, was not at all satisfied with this "deadlock," and entertaining the opinion that one of the ways to cure an evil was to ascertain its extent and real nature, wisely addressed himself to the principal authorities, rehearsing what he understood to be the actions on one side and the grounds of complaint on the other. That letter, written some months ago, has evidently been the subject of study and discussion in the German Patent Office, as we are now able, through the courtesy of Dr. Müller, to give the reply of President Hauss to his communication. We give this highly important document below in English and trust that its appearance in our pages may be the first step toward that harmony and better understanding which always follow when two well-meaning parties to a dispute get a clearer comprehension of the status and arguments of each other. The letter of President Hauss follows:

Your favor of December 27, 1904, touches some questions which, independent of your statements, have been made the subject matter of fundamental considerations in the Imperial Patent Office. These considerations have only been recently brought to a definite close, so that now I am enabled to answer your letter. I assume that an answer, in spite of the delay due to the circumstances, will still be even to-day of some interest to you, and I for my part will gladly make use of an opportunity to explain misunderstandings which seem to be prevalent among American interested parties concerning the practice of the Imperial Patent Office.

In complaining about a too severe definition of the term "invention" you refer especially to the fact that the proof of a "new technical effect" is lately more often required than it appears advisable according to circumstances.

Concerning this point I beg to remark that the said phrase often should only be regarded as an expression to the effect that in the opinion of the examiner there is lacking in the subject matter of the application any considerable effect. Such an estimate, whether the invention, in as far as it is new, exceeds that which also an "ordinary workman" is able to do, must be left to the examiner and the departments of the Patent Office. It is of less importance than the expression that is used by the Patent Office in refusing a patent. However, I have taken care that the phrase requesting to prove a new technical effect is limited to those cases in which an industrial process does not come into question except from the mechanical viewpoint and when the stated technical effect is so improbable that a proof must be demanded.

In the matter itself, the Patent Office does not finally decide as to the standpoint which is to be taken in the estimation of the subject matter of an application as an invention. In the proceedings for the annulment of a patent this question is rather subject to the judgment of the Supreme Court. This institution has set down a series of principles concerning the definition of the term "invention" in numerous decisions which partly have caused the annulment of the patents, principles which the Patent Office cannot leave unobserved in its proceedings for the granting of patents without great injury to the interested industrial branches.

However, the Supreme Court as well as the Patent Office do not at all assume the severe standpoint which is characterized in your letter and the enclosures. If for instance it is said that in Germany "every invention must contain a new principle" or that "that which does not radically differ from a known principle will not be protected" or that "an application is rejected if the theoretical effect is anticipated" or that "the theory of technics is more advanced than the practical side of the industry," or that "an invention is not patentable if the combination contains even a single known element," these are exaggerations which are shown to be such by the reading of German patents, and by the fact that about 10,000 patents are annually granted in Germany, whereas nobody will say that fundamental new inventions are remotely made in any such number.

All this is true of applications by American inventors and in the same degree of applications from other countries, and particularly of Germany. The reproach which is so often made, I regret to say, by Americans, and is also repeated in your letter, to wit: that American applicants are worse treated than Germans must be positively rejected as not based on facts. According to the *Official Statistics*, patents were granted on applications from Germany in 1901, 6,609; in 1903, 6,334, decrease, 4.2 per cent; from the United States, in 1901, 1,094; in 1903, 1,069, decrease, 2.3 per cent. The decrease of patents, therefore, granted to American applicants was about half as large as that for German.

Moreover, the absolute decrease of granting of patents in both countries is no proof, since only the proportion of the patents granted in a certain period with relation to the applications disposed of in the same time can be taken as a true gauge as to better or worse treatment. In this respect separate statistics for the single countries have not been made. If, however, the applications of a certain period are to be compared with the patents granted in the same time, it is shown that on 100 applications of the German Empire an average of 34 patents were granted in the years of 1901 to 1903, whereas on 100 applications from the United States an average of 59 patents were granted, as shown by the statistics referred to. In the year of 1904 the proportion had become still more favorable with respect to the United States, for according to the latest statistics only an average of 31 patents were granted on 100 applications from Germany in the years of 1902 to 1904, whereas on 100 applications from the United States during the same period an average of 59.1 patents were granted.

How in view of these official figures a worse treatment of American inventors can be continually spoken of, is beyond understanding. I leave it to you to give a very large circulation to the figures which show the injustice of such an opinion.

It is true, however, that American applications present special difficulties to the Patent Office in Germany and make constantly repeated criticisms necessary. The reason lies in the difference of the laws and rules of practice of the two countries, and also in this that American inventors and their representatives often think that they can demand that their applications filed in Germany shall be treated according to the laws and rules existing in America. It is very often the case, I regret to say, that, be it at the express wish of the applicant, or be it on account of the lacking experience and the carelessness of the representative, an application is filed here in the same form and with the same claims as it has been filed with in America. The papers, therefore, are not prepared in such a way as to take into consideration the differences between the principles existing in Germany and in the United States. This means a great and unnecessary burden for the German Patent Office. *The American inventors are themselves to blame for the delays which result from their actions.* They cannot demand that the German Patent Office shall cease to enforce the German rules of practice. How far in this direction the baseless demands go is shown by the letter of a firm in Philadelphia enclosed with yours, which firm expresses the desire "that such applications as have passed the rigid examination here could be allowed without further trouble in Germany, unless some new and better reference could be discovered."

If this is meant really in earnest, it cannot even be discussed. The German Patent Office, as long as a treaty does not provide for the contrary, is justified, and is obliged to examine American inventions with respect to the fulfillment of German requirements, just the same as German applications in America are examined by the corresponding authorities of the United States.

In this respect reference should be made to the report of the United States Consul-General, Frank F. Mason, dated September 9, 1901, printed in the Consular Report, Vol. 67, No. 254, page 337, etc. There the true causes of the delays, to which American inventors subject themselves in their dealings with the German Patent Office are shown by a person whose fairness of judgment should certainly be recognized in America. The reading of this report cannot urgently enough be recommended to those of your countrymen who believe themselves to have a reason for complaint, concerning the treatment of their German applications.

Indiana District Independent Telephone Meeting.

The first meeting of the independent telephone men of the Third District in Indiana was held at Logansport on October 28. There were 35 independent telephone companies represented operating about 16,000 telephones. Walter J. Uhl, vice-president of the Third District, presided. It was deemed advisable to make a very close organization in the Third District and to this end a chairman was elected for each county in the district. Thereupon George Seybold, of Logansport, was chosen chairman for Cass County; Dr. J. E. Yarling, Peru, for Miami; Dr. R. F. Blont, Wabash, for Wabash; T. E. Hanway, Monticello, for White; A. B. Diggs, Winainac, for Pulaski; E. B. Walker, Delphi, for Carroll; C. W. Brand, Rensselaer, for Jasper.

Charles F. Norton, of Indianapolis, secretary and treasurer of the State association, explained the method and plan of organizing the respective districts, and made a very flattering and encouraging report of the progress being made in other districts and the remarkable interest manifested at district meetings already held.

George W. Beers, of Ft. Wayne, president of the State association, was present and made an encouraging report, as did also Theodore Thorwood, president of the South Bend Telephone Company. The members agreed to have one and possibly two more district meetings before the meeting of the State association in May, 1906.

The New Power Plant for the U. S. Capitol, Congressional Library and Congressional Office Buildings, Washington.

Bids were received about a month ago by the Department of the Interior, Mr. Elliott Woods, superintendent U. S. Capitol Building and Grounds, for a complete heating, lighting and power plant for what is called the Congressional Buildings in Washington, D. C., comprising besides the Capitol proper, the Library of Congress and the two office buildings for the Senate and the House of Representatives. The work to be done consists of the designing of a complete 8,000-kw power house with sub-stations in the four buildings and with the necessary electric and steam transmissions between power house and sub-stations, and of the furnishing of the necessary material and labor for the erection of the complete plant, which is to be turned over to the Government ready to be put into operation within one year and six months from the date of signing the contract.

The specifications are drawn in general terms only, the object being to have the contractors propose such plant as they consider to be best for the purpose, considering first cost, efficiency, durability, simplicity of construction and ease of operation. This bidding is, therefore, not simply a battle of figures in which the lowest bidder will win, but the nineteen proposals received contain a vast amount of engineering thought, and it is to be expected that the successful bidder will be the one whose design will show the greatest merit from the engineering standpoint.

The general plan provides for a power house containing sixteen (16) boilers of not less than 520 hp each, with suitable superheaters and mechanical stokers, four (4) alternating-current electric generators of 2,000 kw each, with corresponding engines, either of the reciprocating or the turbine type, and all the necessary auxiliary apparatus such as condensers, pumps, feed-water heaters, crane, switchboard, etc., and the required piping and wiring between the different pieces of machinery. Then there will be a sub-station in each of the four buildings mentioned above, and each sub-station is to contain a prescribed number of transformers and rotary converters, with a total capacity of about 6,500 kw and the necessary switchboards. Finally there will be a very complete system of underground conduits containing a set of electric cables as well as the necessary piping for supplying heat to the four different buildings. One of the clauses of the specification stipulates that every piece entering this plant shall be the very best of its respective kind, and the installation as such is to be made a model plant in every way.

Following is a schedule of the bids that were received, from which it will be seen that several of the competitors have put forward one or more alternative projects: Lynch & Woodward, Boston, Mass., $862,726; MacIntosh, Seymour & Co., New York, $903,730; The Scofield Co., Philadelphia, $1,015,450, $974,100; The Hanley, Casey Co., Chicago, $1,047,297.85, $1,031,198.85, $971,197.85, $947,885.85, $1,083,697.85; J. G. White & Co., New York, $1,189,250, $1,059,299, $1,199,868, $1,033,646, $995,675; Muralt & Co., New York, $1,164,700, $1,119,800; The Westinghouse Co., New York, $1,119,584, $1,084,369, $901,736.

To consider these nineteen bids a committee was authorized and has been composed as follows: Col. Charles S. Bromwell, Corps of Engineers, U. S. A., chairman; Mr. C. P. Gliem, chief electrical engineer, U. S. Capitol; Dr. S. W. Stratton, chief Bureau of Standards; Mr. Charles Titlow, chief engineer, Library of Congress; Mr. Richard Harding, electrician, Library of Congress; Prof. S. H. Woodbridge, Institute of Technology, Boston, Mass. This committee is meeting almost daily to look into the advantages of the various proposals, and its members have heard, besides the explanations of the bidders themselves, a series of opinions from eminent experts in the different branches comprised in this project. But the bids are so voluminous and the work of properly considering them, therefore, so arduous that it may be some time yet before any conclusion will be reached.

The New York Central-New Haven Situation as to Traction Systems.

Considerable attention has been attracted to the recent letter of Mr. Frank J. Sprague published in our columns discussing the proposal of the New York, New Haven & Hartford Railroad to operate single-phase locomotives over the direct-current section of the New York Central and into the double-decked terminal at the Grand Central Depot. We have already published Mr. Calvert Townley's comment in reply to Mr. Sprague, and we now note that Vice-President Mr. E. H. McHenry, of the New Haven system, has made some further remarks in the New Haven *Register*. We quote him as follows:

"The new electric engines of the New York, New Haven & Hartford Railroad now under construction by the Westinghouse Electric & Manufacturing Company are of the interchangeable type. They are expressly designed to operate under all practical conditions within wide limits. They will be able to use both alternating current and direct current, high-tension or low-tension alternating currents, to take current from the 'deadly third rail' or from overhead conductors, from high conductors or low conductors at varying heights between 14 ft. and 22 ft., and to operate with equal facility on either or both of the two track levels of the Grand Central Station.

"On sections equipped for direct current they will operate in every respect as direct-current engines of high commercial efficiency, and on sections equipped for alternating current, with still higher efficiency.

"They are subject to but three inherent defects, all of the same order, viz.: They are not able to turn a square corner, to climb a tree or to please Mr. Sprague.

"The adoption of this most flexible type of engine by the New Haven company introduces no new features or difficulties in the track, equipment or operation of the Grand Central terminal, and will not entail upon the New York Central the necessity for the expenditure of an additional dollar nor the transposition of a wire.

"It would certainly seem, therefore, that no departure from the standards established by the Electric Traction Commission of the New York Central Railroad could be less objectionable from any point of view.

"The public is informed that its interests are imperiled by the action of the New Haven company, but so long as travelers resist all temptation to sit on the third rail or to 'skin the cat' on the trolley they can safely ignore the harrowing technicalities elaborated by Mr. Sprague.

"Regarding the multiple-unit system, the New Haven company has been lately assured by competent authority of the perfect feasibility of adapting interchangeable alternating and direct-current motors to such service, subject to disabilities of increased weight and cost, and the New Haven company is, accordingly, not estopped from the use of this kind of equipment should it prove desirable. The adoption of this equipment is, however, subject to other considerations quite independent of motor design and control, and is still under consideration.

"In view of the possibilities above disclosed, it would appear that the 'three years of vacillation' referred to in Mr. Sprague's complaint, have been used to good purpose, and it seems to our company most unfortunate that further time is now lacking in which to 'vacillate' some more.

"In these remarks no discourtesy is intended to our Dr. Jekyll, of the Electric Traction Commission, as it has been made quite clear that he is in no wise responsible for the opinions of that well-known individual in private life, the degenerate, Mr. Hyde."

We are in receipt of the following general rejoinder from Mr. Sprague: "I have noted with some interest the comments called forth by my communication on the subject of the New Haven road's decision to adopt alternating-current locomotives for equipment and operation on the New York & Stamford Division. One of my critics says that I don't know, another that the possible future benefits may warrant any present inconvenience, and a third has it that the New Haven road may 'fly the coop' and abandon the Grand Central Station.

"All very interesting, no doubt, but somewhat wide of the mark, and I recommend to those who disagree with my conclusions a second and more careful reading, keeping in mind the specified existing conditions, before retiring with too much modesty behind a curtain of reluctance to publicly discuss engineering questions of great public interest, or losing themselves in shadowy speculations of a coming electrical millennium.

"With all due respect I beg to say that I see no reason to change my expressed convictions as to the general character of the decision announced by the New Haven people, even if pleading guilty to being 'unfamiliar with the up-to-date development of electric locomotives'—especially the unfulfilled promises—of which defect in my engineering equipment I am, of course, painfully aware.

"Despite my critical attitude, which seems to have given some concern to a few people, and which time will show whether justified, I am beginning to believe that I am a better friend of rational alternating-current development, applied in a rational way to railway operation, while maintaining that the limit of direct-current operation is by no means reached, than a majority of those who sing its praises on a single strident, but ofttimes unmusical note—even if I am unwilling to see its present injection into the densest section of the train movement of two great railway systems, with almost inevitable adverse consequences. Nor is it fair to the alternating-current system itself.

"A proverb says: 'A prudent man seeth the evil and hideth himself; but the simple pass on and suffer for it.' What a lot the future holds for some of us!"

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PAUL M. LINCOLN.

Paul Martyn Lincoln was born January 1, 1870, in Norwood, Mich. While quite young his parents moved to Painesville, Ohio, where he received his common and high school education, graduating from the high school in 1888. After spending a year at Adelbert College in Cleveland he went to the Ohio State University in 1889 to take a course in electrical engineering. Here he always stood close to or at the head of his class, and taking much interest in athletics, was made captain of the football team in 1890. Early in his senior year he went to work for the Short Electric Company and later for the Brush Electric Company at Cleveland, Ohio, but by continuing his studies outside of school he was enabled to graduate with his class in 1892.

During the year he worked for the Short and Brush companies in Cleveland, Mr. Lincoln was engaged in draughting, experimental and construction work. He left there to enter the employ of the Westinghouse Electric & Manufacturing Company at the Pittsburg factory, where he worked for about two and one-half years doing experimental development work in connection with railway generators and arc machines. He left the Westinghouse Company in May, 1895, to take a position with the Niagara Falls Power Company, where he remained until May, 1902, serving under the various titles of assistant superintendent, electrical superintendent and resident electrician. During this time he had charge of the operation of the electrical plant and the supervision of the various engineering problems arising in connection with the generation, transmission, distribution and use of Niagara power. After serving seven years in this capacity, Mr. Lincoln returned to the Westinghouse Electric & Manufacturing Company; there he did general engineering work, chiefly connected with power transmission work and the development of the single-phase railway system until September, 1904, when he was appointed to his present position of engineer of the power division of the engineering department.

While with the Niagara Power Company, Mr. Lincoln possessed exceptional advantages. In this great plant, which was a pioneer in the use of such large generators and the transmission of power at high voltages, many problems were met and solved, and no small portion of the success of the plant is due to his ability and keen judgment. It was while here that he invented the synchronizer known by his name, for which he received a medal from the Franklin Institute, and also a frequency indicator, both of which are largely used in commercial operation.

Mr. Lincoln has served as a member of the special committee on High-Tension Transmission of Power of the American Institute

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of Electrical Engineers, before which body he has presented several papers bearing on this subject. In 1901 he presented a paper before the Franklin Institute, Philadelphia, on "The Parallel Operation of Alternators," and the same year read a paper at the annual meeting of the American Institute of Electrical Engineers on the "Synchronizer and Frequency Indicator." Before the Canadian Society of Civil Engineers, in 1903, he presented a paper on "Interurban Traction Systems—A. C. vs. D. C.," and in the following year read a paper before the Engineers' Society of Western Pennsylvania on "The Adaptation of Alternating Currents to Railways."

Mr. Lincoln is a member of the American Institute of Electrical Engineers and was Chairman of the Pittsburg Branch of the Institute during the first two years of its existence. He is also a member of the Engineers' Society of Western Pennsylvania.

CURRENT NEWS AND NOTES.

ELECTRICITY IN CANADA.—The census report of Canada, third volume, just issued, gives the Dominion in 1901 fifty-eight electrical plants, with $11,891,025 capital, and products worth $2,008,017. These were all, probably, central stations. There were also 25 electrical apparatus plants with $5,267,397 capital and products worth $3,032,252.

AN INVOLUNTARY ADMISSION.—Considering the hostility of the gas companies to the sale of electricity in competitive fields, it is a trifle amusing to find in the very heart of a gas appliance exhibition incandescent lamps used to demonstrate the beauty and translucent qualities of lamp shades, supposed to be illuminated in practice by gas burners alone. This time the joke is "on" the Boston Consolidated Gas Light Company, as any visitor to the Hub may see for himself at the West Street exhibition rooms, provided he arrives before the gas officials realize their inconsistency!

MAGNETIC CLUB.—The Magnetic Club will hold its annual autumn meeting at the Hoffman House, New York, on Wednesday evening, November 15. Dinner will be served at 6:30 o'clock. Delegates to the annual meeting of the Telegraphers' Mutual Benefit Association, which will be held the same day, will be guests of the Club. Other distinguished guests will also be entertained. The committee of entertainment will provide an interesting programme.

SALE OF LIGHT AND POWER.—The adoption of progressive ideas by the New York Edison Company is again shown in the fact that last week it had a lecture given in the Edison auditorium on the sale of electric light and power, by Mr. A. F. Sheldon, president of the Sheldon School of Scientific Salesmanship. The lecture was very well attended, and the greatest interest was exhibited by the large selling and canvassing force of the company.

ELECTRIFYING WEST SHORE.—Mr. C. S. Saunders, president and general manager of the Buffalo Pole Line and Constructing Company, states that he is ready to begin the preliminary work of electrifying the West Shore Railroad for a distance of 81 miles, between Rochester and Syracuse. It is expected that both freight and passenger business on this section of the West Shore road will be operated by electricity next summer.

REMARKABLE TELEPHONE GROWTH.—The New York Telephone Company announces a gain of 5,015 stations in October, and 27,000 between January 1 and November 1. This is a gain of over 600 a week or 100 every working day. It appears that there are now in service and under contract 233,999 telephones in the five boroughs of Greater New York. It is interesting to note that the gain in Chicago in October was 2,126, giving a total of 137,712. Thus the grand total for the two cities at the end of the month was very close upon 375,000.

WIRELESS FOR CZAR.—A special dispatch of November 3 from Berlin says: "Wireless telegraphy is in use between Peterhof and Memel, the nearest point in Prussian territory at which the government land lines are available. A small German cruiser, the *Luebeck,* lies at Memel, while between there and Peterhof are ten German torpedo boats telegraphing doubtless with the consent of the Russian Emperor. The object, however, is only a subject of conjecture." This is the only report of the use of wireless that has come from Russia during the recent period of line cutting, telegraphers' strikes, etc.

THE CHICAGO TRACTION SITUATION.—Negotiations between the Chicago traction companies and the Local Transportation Committee of the Council have reached a much more business-like stage than ever before. The Council, by two-thirds majority, has a fourth time rejected Mayor Dunne's recommendation to cease negotiations with the traction companies and take other steps for immediately acquiring the lines. In drafting the ordinances, the Local Transportation Committee has called upon Bion J. Arnold for expert estimates on earnings on which to base compensation to the city for the franchise and also to plan routes for the cars through the business district. Mr. Arnold has already reported to the committee on routes, enumerating twelve such, many of them to extend across the city.

TELEPHONE CAB CALL.—A cable dispatch from London of November 4 says: "Some of the so-called progressive papers are this week congratulating the usually slow-to-move post office authorities for putting cab ranks on the telephone system, so that now the shrieks of the porter's whistle, which is the plague of the best residential quarters, will be abolished. Some of the cabmen's shelters have already been joined up, but how does the system work? It is true, one can now call a cab by telephone, but if in a hurry it is better to blow a whistle first of all. The subscriber must call up and say, "Cab rank, please." The exchange then asks what is the cab rank nearest his house and then tells him the number. Next the subscriber must ask to be put on to that number and afterward request that a cab be sent around to him, and by the time it arrives he might have got half a dozen cabs by blowing his whistle at the door."

WESTERN ELECTRIC ROADS.—It is noted that the remark of President Hill that the Far West was well supplied with steam railroads and that increased transportation facilities would probably be in the way of railroads operated by other power, comes at the same time with various reports from the Pacific coast of proposed construction of electric lines. The city council of Portland, Ore., has before it an application for a purchase for an electric railway which is to run through Portland to the Willamette Valley by a route which will open new territory and also tap the Coos Bay region. The road is to be laid with 80-pound rails and standard gauge. The first section of the road is to run to Salem, a distance of 52 miles, with Roseburg, 146 miles farther on, as the objective point. This route would practically parallel the main line of the Southern Pacific to Portland. Another project which is being promoted is the construction of a railroad from Portland to Nebalem and Tillamook on the coast. Grading is now to be rushed. The road will run through heavy timber land.

TURKISH PREJUDICE.—U. S. Consul Thomas H. Norton, of Smyrna, calls attention to the construction of tramways in Asia Minor, and believes that American construction companies may find business there. "The municipal authorities of Koniah have decided upon the construction of a tramway, 2 kilometers in length, connecting the city with the station on the line of the Bagdad Railway line. Specifications are deposited with the governor-general of Koniah, to whom interested parties can direct their correspondence, preferably in French. Material (purchased in Europe) is now on hand for the construction of the tramway in the island of Samos, 50 miles south of Smyrna. The projected tramway in Koniah will be the first attempt at introducing a modern urban transportation system in the interior of Asia Minor. The example will probably be followed by other cities, and the field is worthy of the attention of American construction companies. It is unfortunate that the prejudice against the introduction of electricity as a motive power still continues in Turkey. The construction of horse-car lines here may possibly offer a market for the sale of discarded American street cars."

MARCONI TRANS-ATLANTIC WORK.—According to information received from Halifax the Marconi people contemplate another change in the site of their Cape Breton station. Representatives of the company have been at Lorne Head, near Louisburg, 25 miles from the present station, looking over properties suitable for a site for the proposed new station. This would be the third change, as the second station, which is located at Glace Bay, four miles from Table Head, is only about completed. A chief trouble with the Glace Bay station is that while messages can be transmitted from there, it is not possible with anything like equal facilities to receive. This has been the point where failure has come. It is thought that if a new station at Lorne Head is built it will be used for the reception of messages, while that at Glace Bay is reserved for transmission. The cost of the first Table Head station was practically defrayed by the money given to Marconi by the Dominion Government when he first determined to erect trans-Atlantic stations in Nova Scotia. The present Glace Bay station has cost over $150,000. Nothing definite will be done until Mr. Marconi arrives.

GAS COMPANIES AND PUBLICITY OF ACCOUNTS.—In his presidential address before the recent meeting of the American Gas Light Association at St. Louis, Mr. E. G. Cowdery declared himself in favor of the principle of publicity on the part of all public service corporations, and said that if the results of the efforts and operations of gas companies are published broadcast the greater portions of their troubles will have disappeared. As the purposes of gas companies, he said, are honest in every particular, as it costs something to manufacture gas, something to maintain a plant and distribution system through a series of years, something for the distributing accounting management and taxes, and as the total of these must be represented in a cost upon each 1,000 cu. ft. sold annually, he asked why it would not be better to educate the public to the true facts concerning methods, management and interests, than to allow it to remain under a cloud of obscurity to the detriment of the gas companies. He was opposed to State Commissions like those of Massachusetts and New York, but believed that publicity with good management and with due regard for the rights of the public will prevent any need or call for State Commissions.

AUTOMOBILE CLUB OF AMERICA has reached its 700 limit of active membership and has a long waiting list.

VERMONT ELECTRICAL ASSOCIATION.—At the recent meeting in Rutland, Vt., of the Vermont Electrical Association the following-named officers were elected: President, E. E. Gage, of St. Johnsbury; first vice-president, George S. Haley, of Rutland; second vice-president, E. E. Larrabee, of Bennington; secretary and treasurer, C. C. Wells, of Middlebury.

WIRELESS ON THE PACIFIC COAST.—Two wireless telegraph towers and a station are being erected on Mount Tamalpais in California by the Pacific Wireless Telegraph Company. The towers are 300 ft. high and the distance between them is 100 ft. It is thought that this station will be utilized in communicating with Honolulu and with transpacific liners.

WASHINGTON PLANT ACCIDENT.—At Washington, D. C., on November 1, an explosion occurred in the works of the Washington Electric Light & Power Company, by which two men were killed and six severely injured. The twenty-eight-inch pipehead that blew out, it is said, was a new piece of equipment. A special dispatch says that last winter the President had to complain directly to the District Commissioners that the company was persistently defying the law against the use of soft coal. The smoke from the power plant caused serious annoyance to the occupants of the White House and was blackening the exterior walls of the building.

ENGLISH TROLLEYS POPULAR.—A consular note remarks that the increasing popularity of the electric trolley in Great Britain is shown by the annual railway returns recently published. In 1903 there were only five and one-half millions more third-class railway travelers than the previous year, while the tramways showed an increase of 287,496,000 passengers. The gain in 1904 in third-class railway passengers was a little over 6,000,000, but the tramways gained over 117,000,000 passengers. Since 1890 the tramways have carried each year more passengers than have been carried in the third-class railway cars, and last year the excess was over 700,000,000. An appreciable portion of this excess is from persons who, having the choice of railway trains or electric tram cars, give the preference to the latter. The English railway companies admit the serious character of this competition.

SANITARY TELEPHONE.—It has been asserted many times that the mouthpiece of a telephone transmitter is a veritable hotbed of disease germs, and much inventive ingenuity has been expended upon the problem of rendering them harmless. In England, according to Consul Mahin at Nottingham, a radical treatment has been applied by abolishing the mouthpiece altogether. The receiving and transmitting apparatus is combined in a small metal case, shaped like a watch, which is held continuously to the ear both in speaking and in listening, the transmitting microphone being made so sensitive that it becomes unnecessary to concentrate the sound waves on it by the aid of any mouthpiece such as is ordinarily used. Mounted on a handle, with a speaking key, the new arrangement is exactly similar to the common combined receiver and transmitter, except that there is no mouthpiece, and the speaker, as it were, addresses himself to the world at large, instead of talking into a trumpet-shaped orifice.

THE MILK ROUTE.—Discussing the rural trolley in the *Independent,* Mr. A. H. Ford says: "Finding that the short freight haul was its least lucrative business, many of the railways in the Middle West gracefully yielded this traffic to the competing trolley lines. The farmer who previously drove his milk and produce to some distant railway station now reins up his horses anywhere along the line of trolley, careless as to whether or not he reaches his destination at any given hour, for soon enough he knows a car must come bowling down the streaks of rust and then all that Mr. Farmer has to do is to wave his hand, pull out one through ticket for each ten-gallon can of milk or sack of produce he wishes to ship to town, and tell the conductor where to put them off. It is needless to say that with such a system in operation it was useless for the railways to hope to compete for small freight within thirty miles of a large town served by a competing trolley line."

GAS ASSOCIATIONS.—At the recent annual meeting of the American Gas Light Association one important question before the body was that dealing with the proposed consolidation of the American Gas Light Association, the Western Gas Association and the Ohio Gas Light Association, all three of which have a large membership and have been holding annual conventions, which have been largely attended by the same people. The report of a committee appointed a year ago was presented recommending that the three bodies be united under the name of the American Gas Institute. This was unanimously adopted. Before the consolidation can be effected the other organizations will have to take action, but it was the general opinion of the members present from the Western and Ohio associations that the action would be heartily concurred in. This will make one strong representative association of all gas plant owners, managers and engineers similar to the National Electric Light Association.

YELLOW FEVER AND TELEPHONY.—With the idea that the depression incident to general business in the fever-stricken districts of the South might be serious to the users of telephone service, the Cumberland Telephone & Telegraph Company, a licensee company of the American Telephone & Telegraph Company, sent out word to those of its customers who were subscribing to the measured service contract as follows: "Owing to the yellow fever epidemic and the consequent depression of business throughout the South, we will withhold the furnishing of the regular monthly quota of coupons for the months of September, October and November, 1905, sending only such as you may order unless you advise to continue regular shipments." Although this liberal offer was made to relieve such of its patrons as found the terms of their contracts onerous, it has developed that the telephone business has not been curtailed by the depression in other lines of business, but has actually increased in the fever districts, owing to the restriction of travel and the desire for intercommunication.

THE TELEPHONE HABIT is something that is without cure, according to the *Wall Street Journal,* which at the same time, in noting this fact, deprecates too much telephony. It says: "The only value of competition in the telephone field is to force the monopoly to improve its service and to lower its charges. Actual and potential competition has in various parts of the country performed this work. But in actual operation telephone monopoly is better than telephone competition, provided it is subject to a comprehensive public control. A company enjoying a monopoly of the telephone utility should be made to understand that while it is a private enterprise to the extent that it is a business for profit, yet it is more than that; it is a public enterprise, and the duty which a telephone monopoly owes to the public is paramount to the duty it owes to its own stockholders. This does not make it right for the public to impose such rates and conditions upon the monopoly as to amount to practical confiscation, depriving it of all chance of profit, and on the other hand it does not mean that a telephone monopoly should take advantage of its position to overcharge its patrons."

DETECTIVE USE OF THE RAY.—An item in the New York *Medical Journal* says: "It is a new departure to examine a man with the idea of detecting in his stomach jewelry that had been swallowed to avoid detection, and the chief of police of Davenport, Iowa, deserves full credit for the originality of his researches. It seems that a negro had formed a passing attachment for a diamond ring that he did not own, and, being surprised by the legitimate possessor, promptly swallowed it, notwithstanding the heavy setting that surrounded the stone. This was suspected at once, and the culprit was forthwith locked up in jail with the diamond still in his possession. As he strenuously denied all knowledge of the missing stone, the chief of police promptly sent for the municipal electric apparatus. At the sight of this the man, imagining doubtless, that it was some new method of torture, promptly confessed. The photograph, however, was taken, and it revealed the position of the ring." This is interesting, but hardly correct. The Röntgen ray has already been used to detect the location of hidden gems in cavities of the human body, and the Japanese Government is said to have used it in mints where gold coins were being stamped, to prevent theft.

NAVY WIRELESS ON THE PACIFIC COAST.—Work is to be commenced at once by the Bureau of Equipment of the Navy Department on wireless telegraph stations at Port Arguello, Cal., and Bremerton, Wash. Other sites that have been selected for stations are San Diego and Table Bluff, Cal.; Point Wilson, Cape Flattery and North Head, Wash., and Cape Blanco, Ore.

LIGHTS ON TRANSMISSION TOWERS.—The Niagara, Lockport & Ontario Power Company will place electric lights on each of its transmission towers. The plan is to surmount each tower with three lights, red, white and blue in color, which will be turned on in the summer months only, as the work of renewing the lights would be too great in cold weather. The line of towers will extend from the Devil's Hole, near Niagara, through Buffalo and Rochester to Syracuse.

HIGH-POTENTIAL ELECTRICAL DISCHARGES.—The recent experimental work in connection with the dispersing of London fogs by means of high-potential unidirectional discharges is well known. In order to overcome the difficulties attendant on the use of statical electrical apparatus for supplying the electricity at the proper potential, Sir Oliver Lodge, according to a patent issued October 31, would employ a Ruhmkorff coil giving a secondary potential of about a quarter of a million volts, and would pass the secondary current through a series of mercury vapor rectifiers in order to render the delivered current unidirectional for charging Leyden jars.

N. E. L. A. PROCEEDINGS.—It is expected that the book of *Proceedings* of the twenty-eighth convention of the National Electric Light Association, held at Denver and Colorado Springs, will be ready for distribution about November 20. The papers, reports and discussions presented at the conventions of this association are now so voluminous they can no longer be bound in one volume, and, following last year's precedent, this book will be issued in two volumes, Vol. II containing the Question Box and Wrinkles, which alone comprise over 700 pages. If the association did nothing for its members during the year but publish these reports, every member might feel that his dues were wisely invested; for not only do they contain profit-bringing information and suggestions, but it is information and advice that can be obtained in no other way.

WIRELESS RECEIVER.—A patent issued October 31, 1905, to Mr. Lee De Forest refers to a method by which the range of commercial apparatus may be greatly increased without involving an increase in the power used at the sending station. The inventor states that the available portion of the expanding field of force is in the form of a cylinder having the sending antennæ as its axis. Any one of a number of receiving antennæ, if sufficiently separated from one another, say, 10 ft. for wires 150 ft. long, absorbs a certain amount of this radiated energy regardless of that absorbed by the others. The inventor, therefore, uses multiple antennæ, which method also makes unnecessary the use of choke coils, which have been employed in the local battery circuit at the receiving station in order to prevent the passing of the Hertzian waves from the aerial circuit through the local circuit, instead of by way of the coherer or other responder.

TROLLEYING MONT BLANC.—A special cable dispatch from Geneva, Switzerland, says: "An army of Italian workmen has been brought here to begin construction of the new electric line which is to take tourists nearly to the top of Mt. Blanc. The length of the line will be about 12 miles, and the electric system adopted is the same as the one in use on the Jungfrau. The new line will start from the little village of La Fayet, in the Chamounix Valley, and gradually ascend the northwest side of the mountain, up to the plateau near the Aiguille du Gouter, at an altitude of 11,619 ft. From this plateau the ascent to the top of the mountain can be made on foot in four hours. The trains will consist of a motor and two passenger cars, carrying about 80 passengers on each trip, and will be furnished with three powerful brakes independent of each other. All the stations will be connected by telephones. The cost of construction is estimated at $2,000,000."

TELEGRAPHY IN CANADA.—A telegram of October 28 from Ottawa, Canada, says: "The announcement has just been made that A. Bruce Smith, of Toronto, superintendent of the construction and maintenance departments of the Great Northwestern Telegraph Company, has been appointed manager of telegraphs on the Grand Trunk Pacific Railway. The announcement foreshadows that the Grand Trunk Pacific is to come into the field as a competitor of the Great Northwestern and Canadian Pacific telegraph systems. In this connection the question is now being asked whether Canada within the next five years will become the arena of a great conflict between the Grand Trunk Railway proper and the Goulds, who are the principal stockholders in the Western Union Telegraph Company, which controls and operates the Great Northwestern. If a struggle should transpire it may be marked by all the bitterness that characterized the fight between the Western Union and the Pennsylvania Railway a few years ago. Whatever may be the outcome it is evident that a third independent transcontinental telegraph company is about to make a bid for its share of the Canadian business. That Mr. Smith's appointment is the first aggressive move in a campaign that may result in some interesting developments by the time the last rail is laid on the new Grand Trunk Pacific line is the opinion of those who are familiar with the progress and stated policy of the Grand Trunk Pacific Company."

CITY TRAVEL IN EUROPE.—Mr. C. T. Yerkes, a cable dispatch says, was interviewed recently as to his rapid transit work. He announced his intention of spending the rest of his days in London educating the Londoner up to the benefits and beauties of the Yerkes quick transit system. "The Londoner," he said, "still has no idea how to travel, and till two or three years ago didn't even want to get about his own city quickly, but the 'tubes' are waking him up. The Londoner is much more anxious to hustle than he was. When people say I am building too many tubes in London I tell them I am counting on the hundreds of thousands of people who never dream of traversing London at all; they would travel if they had the facilities, and when I have supplied these to the stay-at-homes I shall have millions of passengers. When my scheme is complete the Londoner will be able to get from one end of the city to the other or all around it for two pence. It may be incredible to the people in the United States, but there are scores of thousands of people living in the north of London who have never seen the south, and positively millions in the eastern districts who have never been in the west end. Londoners are the worst people to get a move on I ever knew. To see them board and get off a train one would think they had a hundred years to do it in; still they are doing better, and in the end I shall work them down to an allowance of thirty seconds. The best people I have seen to grasp the quick transit idea are the Parisians; in Paris they fill the empty cars in the tube in less time than in Boston."

LONG-DISTANCE TICKER SYSTEM.—Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, has developed a ticker system by which stock quotations, etc., may be transmitted direct from the keyboard located in one city, to and recorded on tickers distributed in the offices of the subscribers in other cities at a distance. Heretofore a complete transmitting plant has been required in each city, which, on account of the expense, has limited the ticker service to places where there are a considerable number of subscribers. Two wires are required to operate tickers locally, making it impracticable to carry the circuits to a great distance, because the cost for wires soon becomes a prohibitive expense. Mr. Barclay has, however, succeeded in accomplishing a long-distance transmission over a single wire, operating the local tickers on the usual two-wire system, without the intervention of the expensive local transmitting plant, which of course includes the salary of a keyboard operator to send out the quotations, in addition to the Morse operators at each end of the wire supplying the quotations. In Mr. Barclay's new arrangement the wire formerly employed for telegraphing the quotations from one city to another is connected direct to the keyboard in New York, for instance, and to the local ticker circuits in Boston, Philadelphia or any other city desired, and all of the tickers in the other cities record the quotations simultaneously with those in New York. It is obvious that Mr. Barclay's arrangement not only reduces the cost of the ticker plant itself, but also effects such economies in its operation as to make it practicable to give a ticker service in cities where heretofore the expense made it unprofitable. A no less important feature of the new system is the time saved by direct transmission.

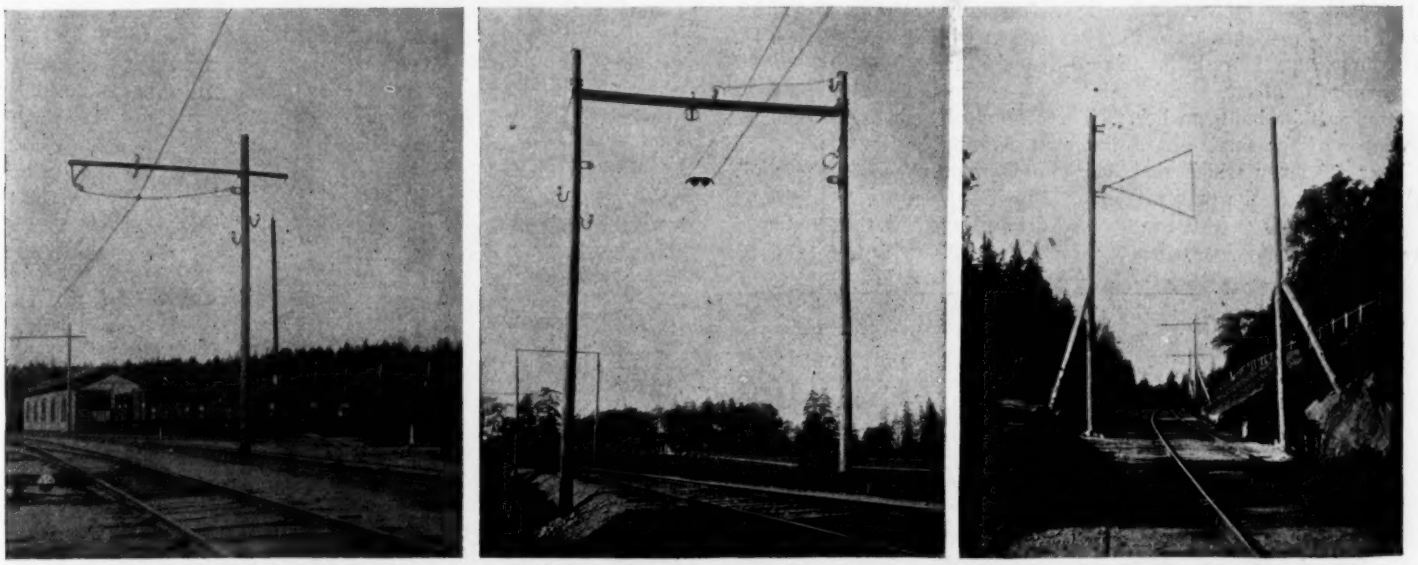
Congress of Swedish Engineers.—III.

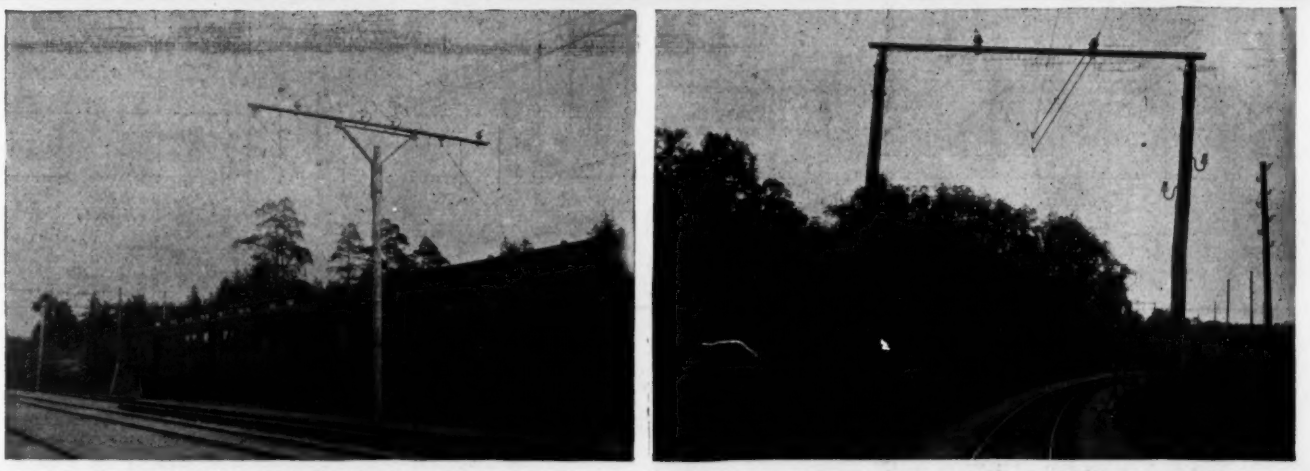
By ARVID WESTERBERG.

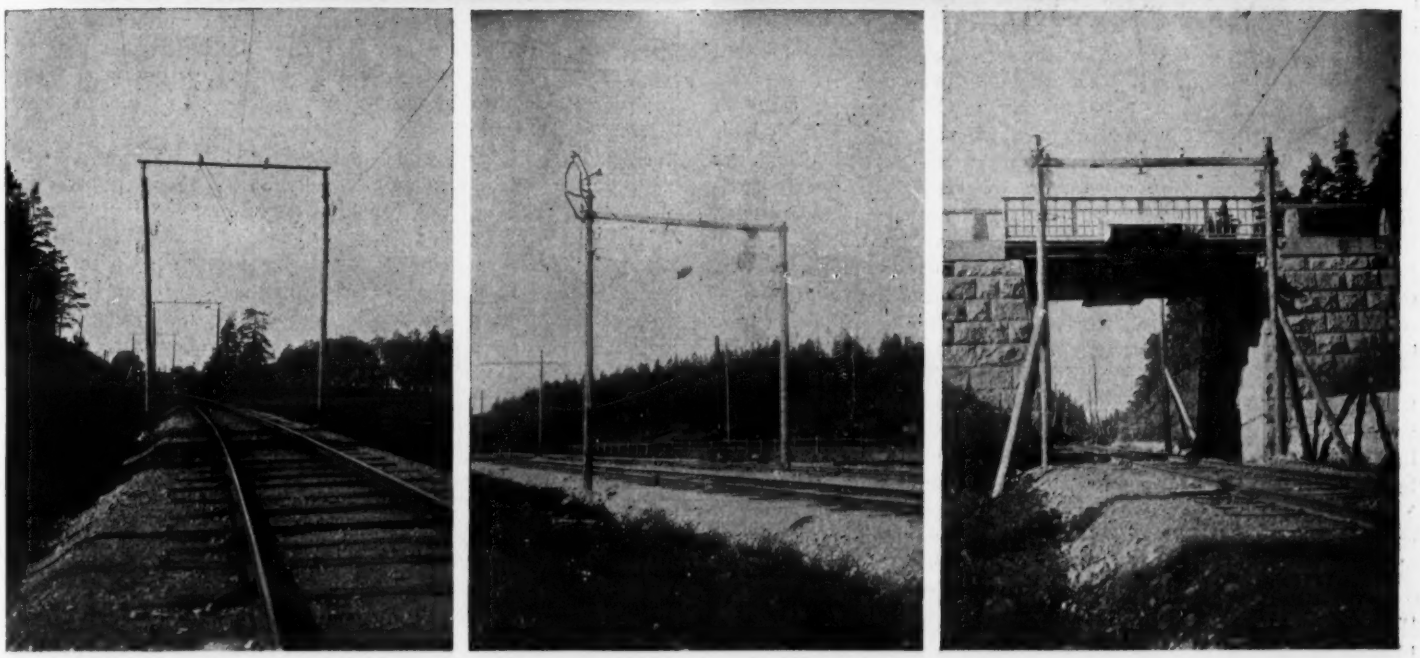
SWEDISH GOVERNMENT ELECTRIC TRACTION EXPERIMENTS.

THE paper presented before the congress by Mr. Dahlander, chief electrical engineer of the Swedish Railroad Administration, was without doubt the most important read at any of the sessions, the subject being the experiments with electric traction now being conducted by the Swedish Government. The first portion of the paper dealt with the reasons why the experiments were to be confined to single-phase traction.

Direct-current systems were ruled out as not applicable to long-distance trunk service. The three-phase has a decided advantage over the single-phase motor in its simpler construction and lower weight, and especially in the absence of a commutator. Besides the necessity of a commutator the single-phase motor has a disadvantage due to the pulsating nature of its torque. A single-phase series motor is capable of a maximum torque corresponding to the maximum current, and the torque is nil every time the current curve







FIGS. 1 TO 8.—VIEWS OF EXPERIMENTAL SWEDISH SINGLE-PHASE RAILWAY, SHOWING DETAILS OF TROLLEY SUSPENSION.

passes through zero. While running this pulsation of the torque does no harm, but at starting it is a disadvantage since it is a cause of slipping. However, if gear wheels are used an elastic effect is introduced which decreases this disadvantage to a certain extent. As a matter of course, the frequency is a factor, since the lower the frequency the greater is the tendency to slip. The tests on this point have only been begun, but it has already been found that a 25-ton locomotive with gear wheels and series motors develops, at 25 cycles, a pulling force of 4 tons.

The greatest advantage of the single-phase motor over the three-phase motor is with respect to economical speed regulation. This is a thing of very great importance for many reasons. On a track with heavy grades a train that has to run with constant speed will, of course, vary more in its current demand than a train that can run economically at any speed. Therefore, in the latter case the power station can be built smaller. The economical gain from this cause in favor of the single-phase motor exceeds by far the few per cent higher efficiency which the three-phase motor has over the single-phase motor at the present time.

The comparison of the motors of the two systems thus shows advantages and disadvantages on both sides. As to supply conductor

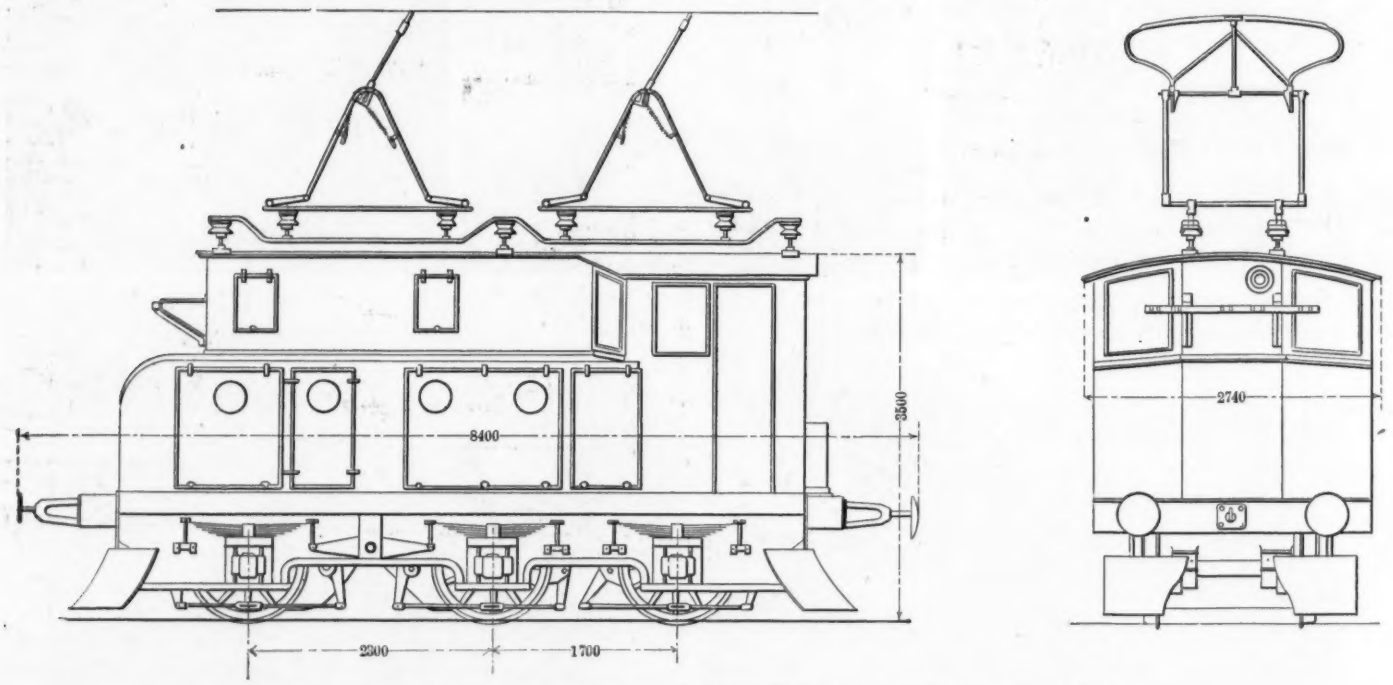


FIG. 9.—SIDE AND END ELEVATIONS OF SIEMENS-SCHUCKERT ELECTRIC LOCOMOTIVE.

it is evident that one wire less is a great advantage. The simplicity in this respect involves a secondary advantage, viz.: the possibility of using a higher voltage, which advantage is especially important in the case of a railway system like the Swedish, with its great distances and comparatively sparse traffic. On the Valtellina road a pressure of 3,000 volts is used, at which voltage difficulties have had to be met with respect to insulation between trolley wires, their supporting wires and the trolley arms. Therefore, it is hardly probable that a higher voltage than 3,000 can be used for three-phase. For single-phase, on the other side, there are roads running with 5,000 and 6,000 volts, and the Oerlikon Company has made successful tests with 14,000 and 15,000 volts. On the Swedish experimental track 18,000 volts have been successfully tried and arrangements have been made for raising the voltage on the trolley wire to 20,000 volts.

On long roads feeders for a still higher voltage than that of the trolley wire will in many cases be required. The three-phase advocates hold out as an advantage for this system that at the same line voltage the copper for a three-phase system will be 33 per cent less than with single-phase system, other conditions being alike. But if the two systems are compared the cost of insulators and line construction is higher for three-phase; the single-phase system is also the most favorable with respect to the feeders.

From the reasons mentioned above, the Royal Railroad Administration decided to choose exclusively the single-phase system for its present experiments.

Mr. Dahlander then proceeded to give a description of the experimental plant and the locomotives and cars to be tested. The power house has a capacity of 350 kw, generated by two De Laval steam-turbine units. The speed is variable so that frequencies of 25 and 15 cycles can be obtained. The voltage of the generators is, at the highest speed, 1,200, which may be raised in two transformers of 300 and 125 k.v.a., respectively, to 3,000, 5,000, 6,000, 10,000, 12,000, 15,000, 18,000 or 20,000 volts. For insulation tests the voltage can be raised to 37,500.

Of the experimental track only 6 km., about 3¾ miles, are ready at present, but 5 km. more are under construction and later more additions will be made. The trolley wire is a round 8-mm., hard-drawn copper wire and is suspended at a height over the rails of 4.7 to 5.7 meters (15 to 18 ft.). Since one object of the experiments is to determine the most suitable method of wire suspension, many different kinds of suspension have been used on different parts of the track. Fig. 1 shows the simplest kind of suspension, an ordinary direct suspension with trolley wire hanger. There is no insulating hanger bell, the porcelain strain insulators that hold the cross span making up the whole insulation of the wire. At every second pole a connection is made to a conductor fastened to an insulator on the top of the bracket arm, and running through two grounded iron rings, held out about a foot from the bracket arm. Now, should a wire break occur, this branch wire comes into contact with one of the iron rings, thus grounding the trolley wire. A similar construction, but on two poles instead of one pole, is shown in Fig. 2. On the greater part of the track the suspension is made by means of one or two steel "messenger" wires as shown in Figs. 3, 4, 5 and 6. Of course, in this way the sag of the contact wire can be almost entirely done away with, thus giving a better contact at higher speeds. The strain on the contact wire can be rendered very small, and also the strain on the messenger wire since this can have a considerable sag without any objection. Figs. 3 and 5 show suspensions of this kind with only one messenger wire and Figs. 5 and 6 show systems with two messenger wires. It is readily seen from the figures that in all these systems the insulation is double, there being one insulator between the pole and the span and cross-bar, and one insulator for the messenger wires. At some places, especially curves, rigid members are necessary in order to hold the wires in the right position, and for this purpose bicycle tubes are used. Fig. 7 shows a section insulator with the section switch mounted on a pole, and Fig. 8 shows the arrangement of the contact wire where the line runs under a road.

Wooden poles are used on the whole line, with the exception of six made of armored concrete located at curves. Of course, the return current goes through the rails, but these are not provided with rail bonds except on a small part of the line. This arrangement is made in order to test whether at the high voltages used, rail bonds will prove necessary or not.

A telephone line runs along the line on the trolley poles. Some experiments regarding the influence of the railway current have

shown that the static influence is considerable, the voltage of the telephone line to ground amounting to about 4,000 volts in some cases. In order to correct this two discharging coils were connected between the two telephone wires and ground. These removed the static charge, but the telephones are provided with high-tension insulation.

The rolling stock to be tested consists of two locomotives and two motor cars. One of the locomotives, which was obtained from the British Westinghouse Electric & Manufacturing Company, was constructed at the Westinghouse shops in Pittsburg; the other was delivered by the Siemens-Schuckert Werke, in Berlin. The American locomotive has two axles and a wheel base of 2.54 m. The wheel diameter is 1.04 m., and each wheel axle is driven by a single-phase series motor of a normal capacity of 150 hp, by means of gear wheels with a ratio of 1:3.89. The maximum practicable speed of the motor being 1,350, the maximum speed of the locomotive with

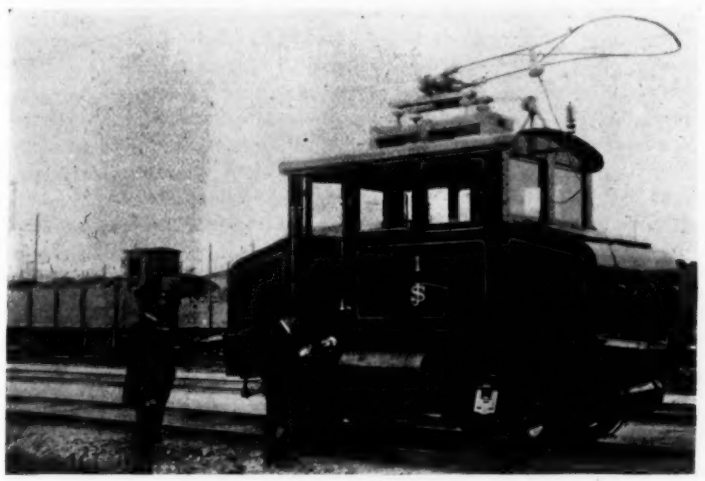


FIG. 10.—PERSPECTIVE VIEW OF LOCOMOTIVE.

this gearing is 62 km. per hour. The gear wheel case is, however, large enough to receive a gearing with the ratio 1:1.75, whereby a much higher speed may be attained. The total weight of the locomotive is about 25 tons. At maximum pulling force the speed is about 28 km. per hour. The primary winding of the transformer is so connected that the locomotive can work with 3,000, 6,000, 12,000, 15,000 or 18,000 volts. Since the details of the Westinghouse railway system is known to American engineers a detailed description of the locomotive, which is shown in Fig. 10, is not necessary. The contact arm shown in this illustration is only a preliminary arrangement consisting of a high-tension insulated contact arm of the same kind that is used on the street cars of Stockholm.

Fig. 9 is a drawing of the Siemens-Schuckert locomotive. This has three wheel axles, each of which is driven by means of gear wheels by a single-phase series motor with a rated normal capacity of 100 hp. The wheel diameter is 1.1 m. Two sets of gear wheels may be used, with a ratio of 1:5.13 and 1:3, respectively. Since the highest speed of the motors is 1,100 r.p.m., the maximum speed of the locomotive is 45 and 77 km. per hour, respectively. At maximum pulling force the speed is 20 km. per hour and 34 km. per hour, respectively. The speed can be lowered by means of the electric regulating apparatus. The locomotive weighs about 32 tons and with ballast about 36 tons. The center distance between axles being 2.3 and 1.7 meters, respectively, the wheel base has a length of 4 meters. All the controlling and regulating apparatus is located in the motorman's cabin at one end of the locomotive, from which one has an unobstructed view in all directions. The contact arms are of a special construction of the Siemens-Schuckert Werke. The main transformer is located above the middle pair of wheels and its primary winding can be connected for voltages of 5,000, 10,000, 15,000 or 20,000 volts. The cooling oil is circulated by means of a centrifugal pump. The second winding is connected to the starting apparatus, from which the motors obtain current at voltages varying between 150 and 300. The high-tension switch and the reversing switch are mechanically connected to the starting apparatus. The motors are cooled by a special fan, by means of which the capacity of the motors is expected to be considerably increased.

The motor cars were built by the Nya Aktiebolaget Atlas, Stockholm, and their electrical apparatus supplied and installed by the Allgemeine Elektricitäts Gesellschaft, of Berlin. The motor truck of each car has two single-phase motors of Dr. Eichberg's system and construction, each motor having a rated capacity of 120 hp. The wheel diameter is 1 meter and the two gearing sets have a ratio of 1:4.26 and 1:2.96, respectively. The maximum speed of the motors is 1,000 r.p.m., and thus the highest attainable speed of the car is 45 and 65 km. per hour. The motor has the characteristic properties of a series motor regarding speed and torque, but is different in that the windings of the stator and the rotor are separated from each other. The stator is wound for a voltage of 6,000 and receives its current directly from the trolley wire without any transformation. The motor has two pairs of brushes; one pair, as in the case of the usual repulsion motor, is short-circuited, while the other pair is connected to a regulating transformer supplying current at different voltages for the speed regulation. The motors of this car thus do not need any transformer for the main current. This is an advantage, but the system has the disadvantage as compared with the system used on the locomotives, in that only one line voltage can be used; and further, that the motor for high-tension is heavier and more expensive than the low-tension motor. This quickly places a limit on the voltages, which from this reason cannot be as high as would be desirable from other reasons.

The motor car is shown on Fig. 11. As will be seen, each car is provided with two contact arms of a special design. It is further provided with a regulating transformer, controlling apparatus and relays for speed regulation. All high-tension apparatus is located in a special chamber, which is accessible only when the contact arms are pulled down. In each end of the car there is a motorman's cabin. The controlling apparatus is like that of the Westinghouse locomotive, being of the multiple-unit system. The auxiliary current for the controlling apparatus is not, however, direct current from a small storage battery, as in the case of the Westinghouse system, but is taken from the mains by means of a transformer. For the heating of the cars an interesting method is used. The current for this purpose is taken from the regulating transformer, so that the heating current is heaviest when the motors take no current, while at full load

FIG. 11.—VIEW OF MOTOR CAR.

the heating current almost ceases entirely. The advantage of this arrangement is evident.

As a conclusion Mr. Dahlander stated the preliminary programme for the experiments, as follows:

The electric railway experiments of the Royal Railroad Administrations will cover principally the following subjects:

The Power Station.—1. Devices for generators and transformers to protect against injury from rise of potential and short-circuits. 2. Voltage regulation at varying load.

The Line.—1. Different systems of suspension, different kinds of insulators and other details of the contact line on free track, at bridges and at stations. 2. Devices to protect against danger from fallen high-tension wires. 3. Protective devices at road crossings. 4. Arrangements of the trolley line at stations and its division into section in order to increase the safety of traffic. 5. Measuring the impedance of the trolley wire and of the return circuit, the latter with different kinds of rail bonding. Examination of the state of

insulation under various circumstances. 6. Investigation of leakage and vagrant currents and of devices to protect against danger or injury therefrom. 7. The influence of the railway currents on telephone and telegraph circuits running along the road and means to prevent disturbances to such circuits.

Rolling Stock.—1. Properties of the motors regarding torque and speed, heating and capacity on short and extended load periods, with and without forced ventilation; sparking, durability; capacity of overload, the utilization of the adhesion weight at different frequencies; efficiency and power factor at various loads; acceleration; gear wheels. 2. Electric starting and regulating devices of different kinds, especially devices for indirect starting with multiple-unit systems. 3. Contact arms of different designs. 4. Measuring train resistance and motor input at different size of trains and at different speeds. 5. Automatic braking systems with vacuum and compressed air. 6. Heating of trains by electricity. 7. Train lighting. 8. Signaling by means of compressed air. 9. Devices on locomotives and cars for protection against danger from high-tension currents.

The discussion following the reading of Mr. Dahlander's paper treated first of the system of suspension. Some speakers thought the suspension by means of messenger wires too complicated and expensive. The advocates of this system held that it was the only possible one for high speeds, as otherwise the poles would have to be located very close to each other, thus increasing the expense. One speaker recommended the Oerlikon system with the contact wire mounted directly on insulators on the tops of the poles. Mr. Dahlander stated that this system had been taken into consideration, but for many reasons it had been decided not to try it in the present experiments. One member of the congress expressed his doubt whether from a national economic standpoint the electrification of the steam railroad system would be justified. Within a relatively short time, he said, all of the water powers of middle and southern Sweden would be taken up by various manufacturing industries; none should be wasted, but electric railroading by water power involved waste where water storage is not feasible. In reply figures were given showing that the doubts expressed had no grounds whatever. The time when all the water powers of Sweden would be taken up by manufacturing industries was very distant. The water powers and turf pits would be sufficient for all the industries and all the railroads for a long time to come. Furthermore, it was pointed out that by synchronizing some stations they could help each other so that a tolerably constant load can thus be obtained.

Roller Bearings for Electric Cars.

In a paper read before the British Tramways and Light Railways Association, Mr. F. W. How reports the results of tests made upon two cars, one being fitted with roller bearings and the other with ordinary phosphor-bronze bearings, the weather and track conditions being precisely the same. The two cars selected were identical in general construction, and weighed, when empty, 10 tons. During the tests both cars were loaded (inside) with 3 tons dead weight, equal to, say, 53 passengers. For the purpose of measuring accurately the current and energy consumed, a recording ammeter in series with a watt-hour was used, and the route covered in each case was 11 miles. In the case of the car fitted with ordinary bearings 47 stops were made, and the energy consumed was equivalent to .90 watt-hours per mile run. In the case of the car fitted with Empire roller bearings 44 stops were made, the energy consumed being .75 watt-hours per car mile. Records have been kept of the runs of these cars from the start, and between October 1, 1904, and September 30, 1905, 14 of the bogie cars on the Croydon system, fitted with roller bearings, traveled 545,898 miles, and one car, fitted with ordinary bearings, ran during the same period 30,988 miles, the total distance run by the 15 bogie cars being 576,886 miles. Assuming that the 14 bogie cars had not been fitted with roller bearings, the extra energy consumed, based on the difference as obtained from the two tests, would have amounted to 79,155 watt-hours, and, at the price paid for the same—namely, 2d. per watt-hour, renewals at 10 per cent per annum, and a further 10 per cent for depreciation, there is a saving of £37 14s. per car per annum, due to the employment of roller bearings. As regards the cost of roller bearings, Mr. How stated that it had been considerably reduced of late, owing to the possibility of casting the "floating cage" so accurately that the expensive machining and fitting, formerly imperative, could be dispensed with.

Voice Overtones, or Harmonics, as Affecting Long-Distance Telephone Transmission.

By D. MacL. Therrell.

As is well known, the sonorous waves or sounds constituting articulate speech involve various fundamental vibrations which are accompanied by numerous other vibrations, ranging several octaves above their fundamental.

The undulatory current created in the electrical transmission of such sounds must, of course, conform to the wave characteristics of the sound so transmitted, being a resultant wave of the fundamentals, together with the many accompanying over and lower tones differing in amplitude, phase and periodicity.

It is found in practice that the fundamentals and the lower harmonics are of comparatively easy transmission over an electrical circuit, while the higher or upper harmonics, upon which we are dependent for the quality and definition of articulate speech, owing to their feeble values, and the infinitesimal time through which these values are operative, are affected and distorted by the various conditions and reactions of the circuit to such an extent as to be degraded on long circuits to the level of their fundamentals, whereby articulation is lost and the transmitted speech rendered practically unintelligible.

It is therefore worth while to endeavor to ascertain whether or not it is practicable to reinforce and preserve these over-tones or partials, to the end that articulation and definition may be conserved and the character and form of the voice waves maintained to the transmission limit of the fundamentals themselves.

This endeavor has been undertaken and a description will be given thereof and of apparatus and experiments resulting therefrom, which, it is believed, will be of more than passing interest to telephone engineers.

Whenever several sonorous bodies in the surrounding atmosphere simultaneously excite different systems of waves of sound, the changes of density of the air and the displacement and velocities of the particles thereof within the passages of the ear, are each equal to the algebraical sum of the corresponding changes of density, displacements and velocities, which each system of waves would have separately produced if it had acted independently; and we may say in this sense, that all the separate vibrations which the separate waves of sound would have produced co-exist undisturbed, at the same time within the passages of the ear. (Helmholtz, "Sensations of Tone"). This generalization is true, not only for the vibrations of sonorous bodies in the atmosphere, but in principle is equally applicable to all media wherein wave motion may be produced or transmitted, since all wave motions are reducible to and controlled by the same laws of motion, in the ultimate particles of matter; the disturbance of the atomic or molecular arrangement of any given medium or body giving rise to a series of displacements, affecting all the particles within the sphere of propagation and causing each particle, after a certain lapse of time to pass through, in a given plane, all possible positions of value around its place of rest or equilibrium.

Such disturbances are known as wave motion, and are in principle the same for sound, heat, light and electricity.

In dealing with the electrical transmission of sound waves such as represent the sonorous vibrations of articulate speech, it has been customary by many, as a result of our tendency to treat sound from a subjective point of view, to consider only the resultant form of the wave corresponding to any given sound, and to treat such resultant waves as if wholly obeying the laws governing the transmission of simple alternating currents. But, since every sonorous sound, with the exception of the simple tones of a tuning fork, is a compound of many complex vibrations, of varying value and phase relation, it becomes apparent that such waves may not be so considered without doing violence to the constituent elementary waves, whose algebraic sum determines the final or resultant wave form, and which co-exist upon the line, independent and undisturbed from an objective point of view.

Let us consider now the component elements of the human voice and the essentials for transforming the sonorous vibrations into electrical vibrations and transmitting the same over long electrical circuits. Speech tones are composed of some prime or fundamental tone and a series of partial tones ranging as high as the sixteenth or more above the prime. The definition of articulate speech is absolutely dependent upon the relative number and value of these par-

tial tones, and their ratio and phase relation to the prime or fundamental; articulation being good or bad in proportion to their dominance or subservience to the first or lower and louder tone. Now, since these upper partial tones are, in comparison with the fundamental, both feeble and transient, it follows that they are often so mixed up with and dominated by their fundamental as to essentially destroy the articulation of even sonorous speech, requiring resonators to detect their existence. This is especially applicable to such words as are characterized by consonant sounds, which are dependent for recognition upon feeble and aspirant noises of estopment or explosion accompanying the consonant letters. (See Blaserna, Theory of Sound, page 165.)

Such being the case, it has been found impossible to transform the sonorous vibrations of articulate speech into equivalent electrical vibrations without great sacrifice of articulation, even for short distances, only about thirty per cent of the speech so transmitted being understood when severed from explanatory context or position.

To improve this condition of affairs much ingenuity and time have been expended upon both the telephonic apparatus and the line conductor, but so far as I am aware, no one has sought to improve or modify the component electrical waves in themselves so as to reinforce the upper partials by varying their relation to the fundamental, and insuring unto them greater relative values and hence both characteristic dominance over the prime and sufficient individuality to maintain their integrity to the limits of the energy impressed. This has been done by me with most satisfactory, not to say remarkable results. These experiments have also convinced me of the influence of phase relation upon the quality of sound.

The quality of a compound or complex tone or sonorous sound wave, depends upon the number and relative intensity of its partial simple tones, and upon the phase relations under which these partial tones enter into composition.

This may or may not be said to throw light on the old controversy over this question, led upon the one side by the followers of the great Helmholtz and upon the other by the brilliant Dr. Koenig, Lord Rayleigh and others, but the fact seems to remain that for electrical sound waves, at least, my experiments coincide with and confirm the mechanical results obtained by Dr. Koenig with his wave siren.

Aware of the brilliant work of Lord Kelvin, Dr. Lodge and Messrs. Hertz and Heaviside in the mathematical discussion of the laws governing the propagation of electrical waves over long circuits, and fully cognizant of the importance of self inductance as a factor of such transmission, I am, nevertheless, constrained by experiments of a positive character to take issue with such conceptions, with reference to open aerial lines, finding as I have, reasons for considering self-induction somewhat in the nature of a mechanical inertia, leading to an increased line leakage proportional to the line inductance and varying with atmospheric conditions.

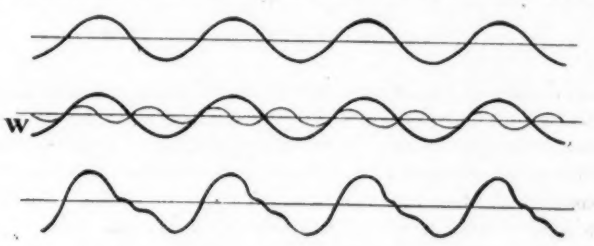
While others have been working to improve the conducting medium so as to increase its conductivity for voice currents, I have, on the contrary, arrived at the conclusion that the conducting medium, as a limiting factor, plays too small a part in the transmission of telephonic currents, to warrant such elaborate and expensive treatment as has been proposed, and instead have sought another solution. From my point of view, the present status of conductors is such as to admit of little improvement, and the problem resolves itself into a question of transmission efficiency, with special reference to over-tones or characteristic partials. This may be stated in other words as follows:

The prime cause of the inability to transmit electrical sound waves without deleterous attenuation lies largely in the human voice itself, whose characteristic partial tones and vocal noises are relatively so feeble in comparison with the fundamentals and lower partials as to be drowned out and lost, even in oral and sonorous sound waves unless particular stress and training is brought into service to conserve and reinforce them. This is amply illustrated by noting the difference in the articulate quality of the speech of children and uncultured persons, as compared with the clear and distinct quality and enunciation in the case of a trained orator, vocalist or elocutionist. In the former case the characteristic partial tones are very feeble and mixed up with the fundamentals, or entirely dormant, while in the latter they are reinforced and controlled as the result of special culture and discrimination. (See Rayleigh, "Theory of Sound," Vol. 2, page 44.)

Consider now the effect upon the resultant of an equivalent electrical voice or sound wave should we selectively reinforce such of the constituent partial tones as are essential to the transmission of the voice characteristics. Suppose that a given series of partial tones be reinforced either mechanically by properly adjusted resonators corresponding to the given partials, or electrically by a proper adjustment of the phase relation so as to superpose or increase their values twice or thrice in proportion to the fundamental and lower harmonics, which are assumed of sufficient intensity; or that such partial tones be superposed or reinforced, while the fundamental and lower tones are reduced. In such a case it is easily seen, that since the intensity of sound increases as the square of the amplitudes, such a relationship would render the partials so treated characteristically dominant over the fundamentals and lower tones whose values have not been raised, or have been relatively reduced. This becomes all the more effective owing to the fact that vibrations of high pitch are more persistent and intense than low ones of the same value, so that for the production of tones of high pitch much less energy is required than for the lower ones, "and yet the higher tones appear to our sensation extraordinarily more powerful than the deep ones." (See Helmholtz, "Sensations of Tone," page 774.)

It is further seen that with such selective reinforcement of the essential partial tones, the attenuation constants of a given circuit may be allowed for and still maintain an ample dominance of the essential characteristics over the lower tones, to the end that articulate quality may be conserved.

Referring to Figs. 1, 2 and 3, Fig. 1 is a graphical curve of a simple sinusoidal wave of an alternating current following the law



FIGS. 1, 2 AND 3.—FORMS OF WAVES.

of sines, and which may be impressed upon a conductor and transmitted according to the well known laws governing the flow of such currents.

Fig. 2 shows a compound wave, consisting of a fundamental and its first octave or partial. As explained above, these waves are separate and distinct in the physical or objective sense, and act and re-act upon each other according to the principles of interference, or the "co-existence and superposition of small motions," to form a resultant wave, which is expressed as the algebraic sum of the instantaneous values of the two component waves. The form of this resultant wave which characterizes the vowel *o* is shown in Fig. 3.

Now an analysis of this resultant wave, into its components, as shown in Fig. 2, makes it evident that such a wave in its resultant form cannot be considered as wholly obeying the laws governing the motions and flow of the simple wave shown in Fig. 1, and especially is this true, when such a compound wave is acted upon by line reactions, or modified by other waves either simple or compound.

For instance, the musical note given by such a wave as shown in Fig. 1 may be easily transformed into an equivalent electrical wave and transmitted without distortion of character to any distance within the limits of the energy impressed. Such, however, is not true for the wave shown in Fig. 3, and in a much less degree for more complex waves. For the sinusoid in Fig. 1 may suffer an attenuation of any percentage of its value by the absorption and reactions of the line conductor without affecting its character, such attenuation merely decreasing its amplitude, and hence its intensity; whereas, a like attenuation of the wave shown in Fig. 3 becomes directly perceptible in its character, and if attenuated sufficiently, the smaller wave becomes entirely wiped out, since the intensity thereof decreases as the square of its amplitude, and hence whatsoever of its value that may remain is lost in the dominant value of its fundamental. Therefore, in treating the complex waves entering into articulate speech, it is imperative, if the best results are to be obtained, that we consider not the wave in its resultant form, but rather the elementary waves that go to make up this resultant.

Referring now, to Fig. 2, which represents the vowel *o*, suppose

it is desired to transmit this wave over a circuit of great length without material distortion of its character. We know that it is an easy matter to so transmit the fundamental thereof, but unless some provision is made for maintaining the integrity of the partial, the said partial is reduced by the attenuations of the line, until it loses its modifying effect upon the fundamental and is merged therewith and hence the original character of the sound is lost. This is particularly true of the more complex waves corresponding to the human speech. But, if we increase the value of the partial twice or three times while maintaining the fundamental wave at approximately its original value, or reducing it, we shall have the resultant wave reinforced and dominated by its characteristic partial and able to withstand the line attenuation without loss of its character.

Referring now to Fig. 4, where we have three sets of complex waves, w', w'', w''', each set being identical with the vowel *o* as

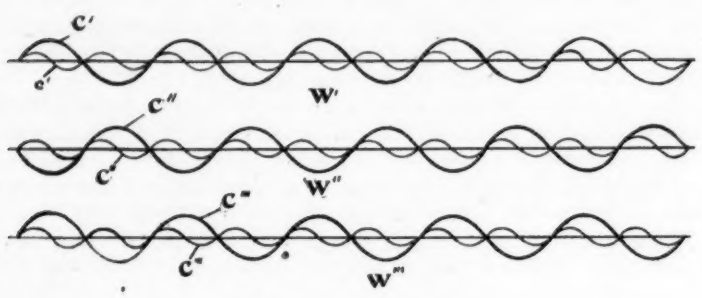


FIG. 4.—COMPLEX WAVES.

shown in Fig. 2, let us consider the laws governing the values of such complex waves when superposed so as to act and re-act upon each other by interference. In this instance we have each set or train of waves displaced by 180 degrees with regard to their fundamentals, or in other words, each set of waves is assumed to lag behind the former by 180 degrees. Now if these series of waves be impressed upon a medium in the order described there will take place a series of actions and reactions by which some of the waves in the constituent series will be destroyed, or neutralized, while others will be increased as the sum of their original intensities.

Since it is a fact that the disturbance of any particle produced by the co-existence of two or more causes, will be the algebraic sum of the disturbances which they would produce separately, let us consider the nature of the displacement produced by the superposition of the action of two waves of the same length on the same particle at a distance, x, from the wave front. Upon this assumption, we have for the first wave: $d' = \frac{a'}{x} \sin\left[2\pi \frac{vt - x}{\lambda} + A'\right]$ and for the second wave: $d'' = \frac{a''}{x} \sin\left[2\pi \frac{vt - x}{\lambda} + A''\right]$ in which d' and d'' equal the displacements; a' and a'' determine the intensities of the sound in the two waves at the units distance; and A' and A'' the places of maximum displacement or angular distance at the expiration of time, t. Now if the component wave lengths λ, be equal and uniform and the arcs of displacement, $A' - A''$ equal zero, the maximum displacement, $\frac{a}{x}$, which determines the intensity of the sound in the resultant wave will be:

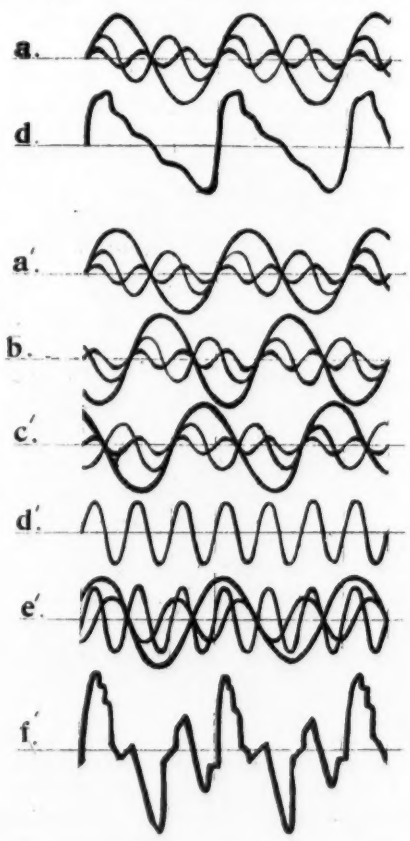
$$\frac{a}{x} = \frac{1}{x}\sqrt{a'^2 + a''^2 + 2\,a'\,a''\,\cos.\,(A' - A'')}$$

(See Bartlett, Acoustics and Optics, pages 65 to 69), or in other words, the waves being directly superposed and in phase will have their maximum value, which will equal the direct sum of the two waves, and since the intensity of sound is directly proportional to the square of the amplitude, the intensity of sound in the resultant wave is quadruple that in either of the component waves. This also applies to the wave motions and values of electrical currents, when the formula becomes the well known electrical equation for the resultant of two waves of different value or phase relation:

$$r = \sqrt{a^2 + a'^2 + 2\,a\,a'\,\cos\,\phi},$$

where, r, is the resultant, a, and a', the component waves and ϕ the phase angle, corresponding to $\frac{a}{x}$, a' and a'' and $A' - A''$, in the acoustical formula.

Now, if a' and a'' are equal and we make $A' - A''$ equal 180 degrees, then the equation gives $\frac{a}{x}$ = zero and one wave completely neutralizes the other. Thus, in Fig. 4, it will be seen that the fundamental wave C' encounters an interference from the fundamental C'' of wave w'' which is of an opposite sign, and being equal in value and wave length, according to the equation, a' equals a'' and $A' - A''$ being equal to 180 degrees the two waves mutually destroy each other. This is not the case, however, for the waves c' and c'', representing the partials, an octave above the primes, for where the primes, or fundamentals, are exactly 180 degrees apart and of opposite sign, thus neutralizing each other, the partials are coincident and, $\frac{a}{x} = \frac{1}{x}\sqrt{a'^2 + a''^2 + 2\,a'a''\,\cos\,(A' - A'')}$, the two waves are directly superposed while the fundamentals are destroyed. Now, wave w''' is impressed upon the line in the same manner as w' and w'' and the same actions and reactions as have been detailed for w' and w'' are performed by this wave for each cycle or wave length.



FIGS. 5 AND 6.—FUNDAMENTAL AND RESULTANT WAVE FORMS.

In this case, however, it will be readily seen, that since the fundamental C' and C'' of waves w' and w'' are operating to neutralize each other, the fundamental C''' of wave w''' is unopposed and impresses its full value upon the conductor. Also that the partial c''' of wave w''' being in phase with partials c' and c'' is directly superposed, according to the formula, which results in the value of the resultant partial being raised to the sum of the values of the three component and corresponding partials, while the fundamentals are so placed in their phase relations that the first two cancel each other, and only the third remains effective.

From such a system of superposed component waves, it will be seen that we get a resultant wave wherein the characteristic partial or partials has three times the relative amplitude of its prime, and hence modifies the prime with the essential sonorous characteristics for articulation. An inspection of these curves will show that the same principle applies for any number of partial tones, the evenly numbered partials, or harmonics being superposed at every instant while the unevenly numbered partials, are partially neutralized or destroyed.

This principle may be employed to neutralize the evenly numbered as well as the unevenly numbered partials of a complex wave, whenever desired, by so varying the phase relations of the superposed trains of waves as to satisfy the terms of the equation.

From a special research of the matter, I have discovered, however, that for speech tones and the necessary characteristics thereof, the best results are obtained by so arranging the phase relations as to superpose and reinforce, relatively to the prime or fundamental, the greatest practicable number of odd and even partials, which is obtained by separating the original current into three component parts and reassembling the said parts or components under phase relations of 90 degrees, or 120 degrees, as regards fundamentals.

Referring now to Figs. 5 and 6, where we have a series of curves of waves consisting of the fundamentals and the first two partials, together with several resultant wave forms, let us now consider the proposition of superposing the unevenly numbered partials of a compound electrical wave corresponding to a sonorous sound wave.

The first unevenly numbered partial is the third partial, or the second harmonic. Therefore, if we so arrange matters as to reinforce the third partial, we shall at the same time reinforce every partial throughout the series which is a multiple thereof, and to a less degree all others within the neighborhood of this reinforcement.

Referring to Fig. 5, at *a*, we have the curves of a complex wave composed of the first three partials, and at *d*, a curve showing the resultant curve or wave form which is the algebraic sum of the series shown at *a*.

In Fig. 6, we have a set of curves, *a'*, *b'*, *c'*, identical with those shown at *a*, in Fig. 5, displaced relatively to each other by 120 degrees, or one-third of a harmonic cycle. From these curves it will be readily seen that for the series the algebraic sum is zero for all except the third partial, which is undisturbed, this is also the case for all multiples of this third partial. This resultant curve is shown at *d'*.

Now, if instead of impressing all three sets of these waves upon a conductor, related as shown, we impress only two sets and shunt most of the third train of the series, say *b'* or *c'*, so as to maintain the integrity of the system, while only impressing upon the line the other sets, we shall have instead of the simple curve shown at *d'*, an entirely new complex series, as shown, *e'*, the resultant of which is shown as *f'*.

Comparing *f'* of Fig. 6 with *d*, of Fig. 5, the difference is at once seen to be one of a rather remarkable kind. The resultant fundamental has been shortened by 60 degrees, the third partial has become independent thereof, and the characteristic discontinuities are seen to be wonderfully more marked and abrupt than at *d*, in Fig. 5, where the wave is long and gradually sloping with ill-defined characteristics. This holds also for all multiples of the third partial present in the harmonic series. It may be generally laid down, as a rule, that the force or loudness of the upper partial tones is the greater, the sharper the discontinuities of the resultant wave. When the wave alters uniformly and gradually answering to the nature of a smooth vibrational curve, only the deeper partials and the prime have any perceptible intensity. (See Helmholtz, Sensations of Tone, page 35.) Therefore, it is seen by these curves, where the third partial is reinforced relatively to the prime and second partial, that the answer to the theory is a positive one.

Again referring to Fig. 6, it will be noted that there are three separate series of complex waves, displaced by a given angular distance. The voice, or sonorous waves acting upon a telephonic transmitter in the well-known manner, generate a corresponding series of electrical waves in the transmitter circuit which are, by induction, impressed upon the line conductors. Now, in order to obtain the condition of affairs upon the line conductors which is shown in Fig. 6, and required by theory, this corresponding electrical complex wave must be divided into three separate series, or its equivalent, and again brought together and impressed upon the line conductors, displaced from each other by 120 degrees, or one-third of the harmonic cycle. To do this special apparatus and circuits have been designed upon the triphase principle, which have proved confirmatory of the selective theory involved, and afforded most remarkable results upon actual long distance tests.

The circuit arrangements used are shown in Fig. 7. In this figure we have the terminals shown at *A* and *B* connected by the ordinary line conductors. *T* and *T'* are the transmitters, *b* and *b'*, C_2 and C_2' are the batteries and transmitter primaries at *A* and *B*, respectively. As the apparatus at *A* and *B* are identical they may be considered and described under references at *A*. 1 and 2 are the secondaries of primary coil C_2 and operate through an inductance *L* and condensers *K* and *K'* into primaries P_1 and P_2 inductively related to secondaries S_1 and S_2 which are connected to line as shown.

As this drawing may not be readily understood as shown, let us consider first, Fig. 8, where P_1 and P_2 are two primary coils of the transformers *A'*, *B'* and *C' D'*, inductively related to the secondaries S_1 and S_2, connected together at *D'* and to lines 1, 2 and 3.

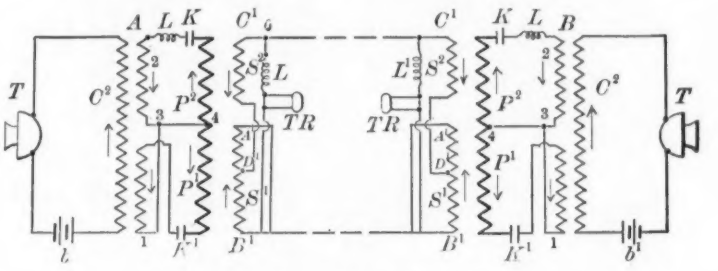


FIG. 7.—ARRANGEMENT OF CIRCUITS.

Now, if the currents in the primaries P_1 and P_2 differ in phase by 90 degrees, the same difference of phase will be impressed upon the electromotive forces generated in the secondaries of these coils.

If we now consider a triangle, *A C B*, Fig. 8, in which the length of each side is equal to unity, and let a line, *C D*, bisect the angle *C*, then *C D* is perpendicular to *A B* and bisects *A B*; hence $A\,D = \frac{1}{2}$, and $C\,D = \sqrt{1 - \frac{1}{4}} = \sqrt{\frac{3}{4}} = \frac{1}{2}\sqrt{3}$. In the right triangle, *A D C*, the angle *A C D* equals 30°, and the angle *C A D* equals 60°, whence $sin\ 30° = cos\ 60° = \frac{1}{2}\ cos\ 30° = sin\ 60° = \frac{1}{2}\sqrt{3}$, $tan\ 30° = cot\ 60° = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$. Therefore, if the secondary, S_2, corresponding to *C'D'*, has $\frac{\sqrt{3}}{2}$ times as many turns as the secondary, S_1, corresponding to *A'B'*, then the e.m.f. between the terminals *C'* and *B'* or *C'* and *A'*, is the resultant of two components, one being the full e.m.f. generated in the secondary of P_2 and the other half of the e.m.f. generated in the secondary of P_1, the latter component being, moreover, displaced by 90° as regards the former component, and the terminal pressures pass through zero at intervals of 120° and are thus impressed upon the lines. Now, if the terminals, *C'* and *A'* of coils S_1 and S_2 be connected to a metallic circuit, while the other terminal, *B'*, be connected directly or through an inductance to *C'*, we will have the counterpart of the line circuits and coils S_1 and S_2 of Fig. 7, whereby the currents are impressed upon the line as per the curves shown in Fig. 6 above described.

It will be noted that the method of securing the diphase currents displaced by 90°, in P_1 and P_2 of Fig. 8, and therefore required in P_1 and P_2 of Fig. 7, has not been described. This is done as follows: Let a current be flowing through the primary of C_2. This generates an e.m.f. in its secondaries, 1 and 2, which form two closed circuits through the coils P_1 and P_2, and are connected together at 3 and 4. As will be noted, these closed circuits include an inductance, *L*, and capacities *K* and *K'*.

Since capacity and inductance, or self-induction act in opposite directions upon a periodic electric current as affecting its phase, it is apparent that by adjusting these values with regard to each other and the resistance of the circuits, we may vary the phase relations of these circuits by 90° or more. The phase difference required by theory is one of 90°, and since the power factor is to be considered even in these circuits, it is preferable to so adjust these values as to make one circuit lag in phase by 45°, while the other leads by the same phase angle, thus balancing the power factor of the system, and impressing upon the primaries, P_1 and P_2, a current of 90° difference of phase, which acts upon the secondaries, S_1 and

S_2, as described heretofore in reference to Fig. 8.

In arranging this phase displacement, certain circuit constants and functions must be observed, and a certain current frequency must be adopted as a base.

Consider now the question of frequency, n. It has been seen that theory calls for the reinforcement or boosting of the upper partials, or in this case the multiples of the third partial. It is claimed by many telephonic authorities that the highest essential frequency of telephonic transmission falls near 750 p.p.s., but since there have been discovered in the human voice as many as 16 partial tones, to say nothing of the characteristic noises accompanying consonant sounds, it seems that much might be gained by considering frequencies much higher than this as speech characteristics. Therefore, in calculating for angles of lag and lead, a frequency of n equals 250 p.p.s. has been assumed as a base, this frequency coming near the average voice fundamental. The third of this base is 750 p.p.s., and from the theory all necessary frequencies are cared for above this throughout the harmonic series.

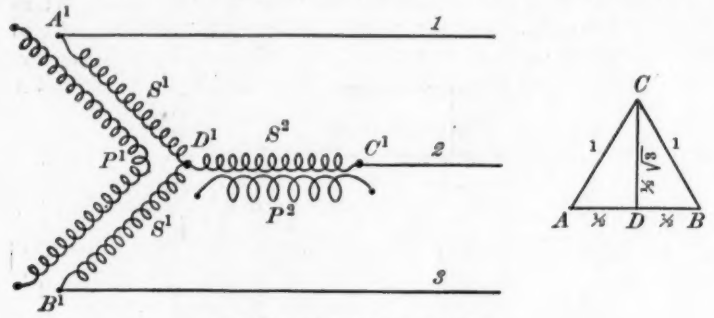


FIG. 8.—DIAGRAM OF PHASES.

One case and one type of apparatus therefor will be illustrated in order that the principle may be clearly understood. From what has been said of the effects of resistance, capacity and inductance, in determining the phase of the current in a given circuit, we may calculate for any given phase angle. The formula is $tan\ \phi = \dfrac{2\pi nL - \dfrac{10^6}{2\pi nK}}{R}$, from which it will be seen that with three of the terms, n, L, K and R, given, we may transpose and find the required value of the other term or constant for any predetermined value of ϕ, which represents the phase angle. To illustrate, suppose ϕ be required equal to 45° of lag, then we have the equation

$$tan\ \phi = 1 = \frac{2\pi nL - \dfrac{10^6}{2\pi nK}}{R},$$ where

n = frequency of the impressed e.m.f.,
L = the inductance in henrys,
K = the capacity in microfarads,
R = the resistance of the circuit in ohms.

Given the frequency, n, as 250 p.p.s., the inductance, L, as .021 henry, and the resistance as 1.1 ohm, and it is required to find the value of K, where the current is required to lag 45°, or the inductance or positive component is to dominate. Then $45° = \phi$, $tan\ \phi = \dfrac{2\pi nL - R}{\dfrac{10^6}{2\pi n}} = 1$, and $\dfrac{2\pi n}{2\pi nL - R} = K = 19.96$ microfarads. For the same given constants, where the current is required to lead by 45°, or the capacity effect is to dominate, the formula becomes $\phi = -45°$, $tan\ \phi = \dfrac{2\pi nL + R}{\dfrac{10^6}{2\pi n}}$ and $= K = 18.67$ microfarads.

In this connection it will be observed that when the expression $2\pi nL - \dfrac{10^6}{2\pi nK}$ is positive— that is, where L is of greater effect than K—the current lags, whereas when it becomes negative—that is, where K is greater in effect than L—the current leads the e.m.f.

As it is required to maintain as much current as possible in the primaries, P_1 and P_2, of coils A' and B', it becomes necessary to keep the resistances of the secondaries of C_2 and the primaries, P_1 and P_2, as low as is practicable. In the case under consideration the secondaries 1 and 2 of primary C_2 contained, each, 480 turns of No. 17 wire and measured .6 ohm, while the primaries, P_1 and P_2, contained 377 turns of No. 18 wire, and measured .5 ohm, making the total resistance of the circuit 1.1 ohm. For this low resistance it was not necessary to insert the inductance coil, L, since the self-induction of the coil P_2 itself amounted to 21 millihenrys (computed). This involves larger values for K than will be necessary when R and L are increased, and also shows that L, R and K may be varied within wide limits without materially affecting the results. It should be mentioned in this connection, however, that since the two secondaries of coil C_2 are practically on short-circuit, thus neutralizing the self-induction of their primary, a very large current will flow therein, giving rise to hysteresis and eddy-current losses proportional to the frequency, n, and the square of the frequency, respectively. It is, therefore, necessary to design the magnetic circuit of coil C_2 so as to work at the lowest magnetic density compatible with efficiency.

It is also of great importance to maintain the highest degree of insulation between the condenser terminals, as leakage losses and dielectric absorption may readily turn success into failure.

New York Central Generating Plant.

The accompanying illustrations show the main characteristics of the two stations now being built by the New York Central & Hudson River Railroad to furnish power for its terminal electric traction service. The size of the main building is 167 ft. wide, 237 ft. long and 105 ft. high. Each will have an ultimate capacity of 30,000 kw, and they will be cross-connected electrically. The number of cubic feet per kilowatt capacity is 102, and the number of square feet of building per kilowatt is 1.49. The switching equipment will be in small buildings about 110 ft. distant from the power house.

One of the buildings is located at Yonkers on the Hudson Division, and the other at Port Morris, on the Harlem Division. The site of the latter was dry ground and the foundations were carried down to rock. At Yonkers, however, the location for the building was entirely in the Hudson River, the water running from a depth of 8 ft. near the shore to 16 ft. at the outer end. The foundation here rests on piles and consists of a concrete structure, water-proofed at one horizontal plane by alternate layers of coal tar, pitch and felt and strengthened above this plane by two courses of round steel rods one inch in diameter laid at right angles to each other in the bed of the concrete.

The two power houses, aside from the foundations, are similar in general design. The base and floors are of concrete, the framework of steel, the walls of brick and tile and the roofs of concrete roofing slabs covered with copper. Special attention was given to the architectural appearance of the stations and an excellent effect is produced merely by the use of common brick and terra cotta of the same general color, relieved through the careful design of the openings and recesses. Special consideration was given to the design of the windows, not only to obtain a well-lighted interior, but also to present an attractive appearance from the exterior at night, since both power houses are adjacent to railroad lines and along the lines of important water travel.

Each power house has two chimneys, 15 ft. 6 in. inside diameter and 250 ft. high above the grate level. The stations are divided by a brick wall into generating room 69 ft. by 231 ft. 8 in., which is open to the roof, and a boiler room 88 ft. wide and of the same length, over which are placed the coal bunkers having a capacity of 3,500 tons. At Port Morris there are three galleries on one side of the turbine room, the first being used as a shop, the second as an operating gallery and the third for offices. At Yonkers the level of the first gallery is carried across the room and is the operating floor with walkways between the generators. The exciters are placed

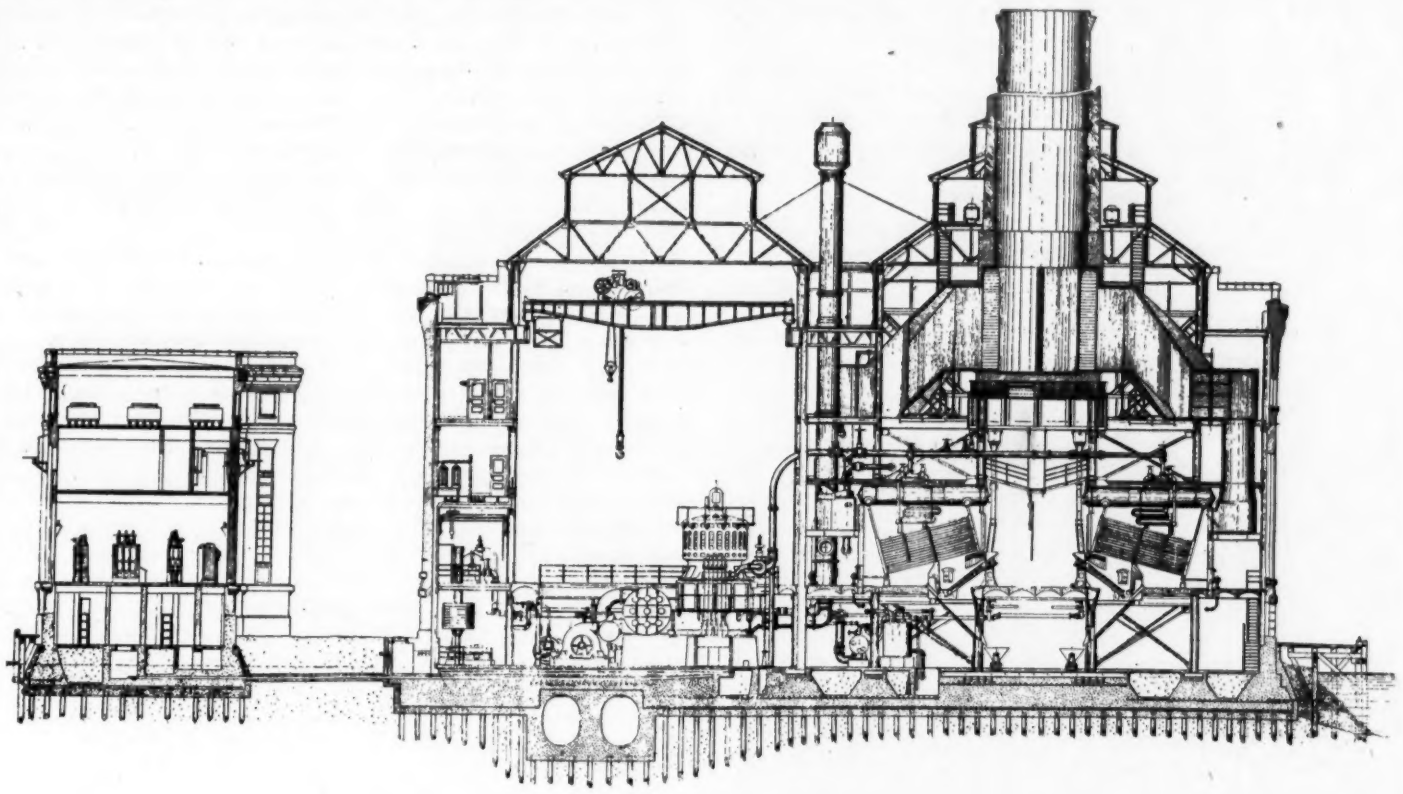


FIG. 1.—CROSS-SECTIONAL VIEWS OF SUB-STATION AND POWER STATION AT YONKERS, N. Y.

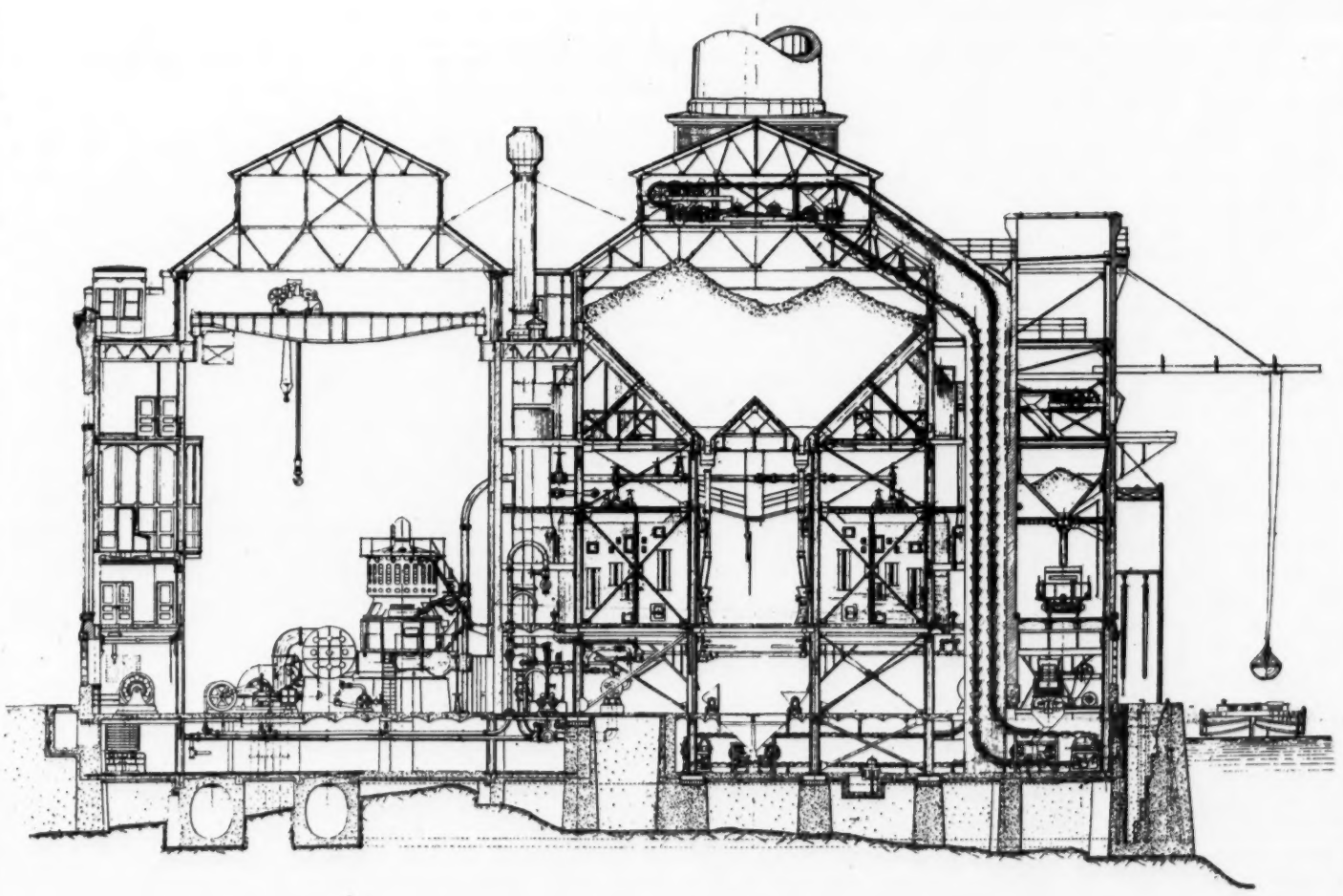


FIG. 2.—CROSS-SECTIONAL VIEW OF POWER STATION AT PORT MORRIS, N. Y.

NEW YORK CENTRAL GENERATING PLANT.

under the galleries on the level of the operating floor, the operating gallery being immediately above them; the top gallery is used for offices and shops. Each turbine room will be equipped with a 50-ton traveling crane having a 10-ton auxiliary hoist.

The coal and ash-handling plant is very complete, though having no particularly novel features. All the apparatus except a steam hoist for unloading coal from boats, is driven by 220-volt, three-phase induction motors, varying in capacity from 7½ hp for the ash conveyor to 40 hp for the coal crusher and conveyors.

In each station accommodation will be provided for 24 Babcock & Wilcox water-tube boilers, each having a grate area of 112 sq. ft. and heating surface of 6,250 sq. ft., thus giving a ratio of 55.8. They are rated at 625 hp each; the steam pressure is 185 pounds per square inch. Sixteen boilers will be installed for initial operation. The steam will be superheated 200° F. by superheaters in each boiler having 1,230 sq. ft. of heating surface.

Each power station is designed to accommodate six 5,000-kw

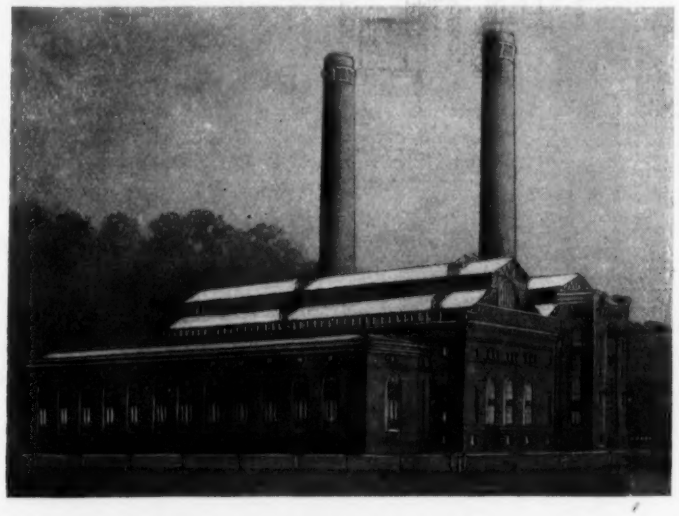


FIG. 3.—YONKERS POWER STATION.

turbo-generators, four of which are being installed for initial operation. The turbines are of the Curtis five-stage vertical type. These machines are about 15 ft. in diameter at the base and 35 ft. high from the floor to the top of the generator.

The turbine structure is mounted upon a cast-iron base, forming an exhaust chamber, in which is provided the opening to the condenser and to free atmospheric exhaust. The shaft of the turbine is separated from that of the generator above, the connection between the two being made by a coupling, so that the machine can be readily taken apart. The shaft is borne by a step bearing consisting of two cast-iron blocks, between which water is used for lubrication under a pressure of 800 pounds per square inch, exerting a sufficient force to raise the moving structure slightly. One individual pump is provided for each turbine for the lubricating system, and in addition to this two larger pumps, in connection with two accumulators, insure uninterrupted pressure at the step bearings.

The governing will be effected by successive opening and closing of automatic hydraulically-operated valves, which deliver steam to the different sections of two sets of nozzles. The turbines will be fitted with two centrifugal devices to check any excess of speed. After either one of these devices operates the next revolution of the machine will bring it into engagement with a lever, which will trip the main steam valve, cutting off immediately the driving power and allowing the machine to come to rest in the shortest possible time.

The condensing apparatus is external to the turbines. The condensers are of the Worthington counter-current surface type, and each is directly connected to its turbine base and contains about 17,000 sq. ft. of cooling surface. They are guaranteed under full load to maintain a vacuum of 28 in. with cooling water at a temperature of 70° F., 30 in. barometer.

The auxiliary condensing apparatus is composed of independent units. Circulating water pumps are of the centrifugal type, directly driven by horizontal reciprocating engines. The dry vacuum pumps are of the rotative fly-wheel type, with air and steam cylinders in tandem, erected on a common base. The hot-well pumps are of the two-stage turbine type, and are driven by direct-connected, direct-current electric motors.

As an evidence of the high efficiency expected of the condensing system, it may be stated that the manufacturer has guaranteed that the temperature of condensed steam measured in the condenser hot well will be within 1° F. of that corresponding to the pressure measured in the condenser. All parts of the machinery have been designed to operate smoothly and quietly under all loads up to 50 per cent above the normally rated capacity of the turbines. The intake and discharge circulating tunnels for the condensing system are elliptic in shape, 7 ft. 3⅞ in. by 9 ft. 11 in.

The generators each have a capacity of 5,000 kw, and are wound for three-phase currents of 25 cycles and 11,000 volts pressure. The armatures are star-connected, and the neutrals are grounded through individual cast-iron grid resistances connected to a common ground bus, limiting the ground current to an amount sufficient to operate the line overload relays. The leads of the generators are brought down to the floor through brass pipes to the ducts leading to the high-tension switches, the arrangement being such that no high-tension conductors are exposed in the turbine room.

The exciter system at each power station will consist of two 150-kw turbo-generators and one 150-kw induction motor-generator, furnishing current at 125 volts pressure; also one exciter storage battery consisting of 74 cells, type R-21, having a capacity of 1,200 amp. for one hour, with spare space in the tanks for increasing the capacity to 1,800 amp. for one hour. The exciter generators and battery are connected to two independent positive buses and one common negative bus. The battery has two end cell switches on the positive side. One positive bus serves for field excitation of the 5,000-kw generators only, while the other serves for certain lights and motors in the station.

The stations will be operated from the operating gallery on the north side of the turbine room. The arrangement of the switchboards in this gallery is symmetrical, and all cables and copper connections running to the switchboards are carried in concrete trenches under an Alberene stone floor. The main operating switchboard containing all the control switches and the instruments necessary for the operation of the station is located in the center of the operating gallery. A set of two exciter switchboards is located on each side; the main operating switchboard as well as the exciter switch-

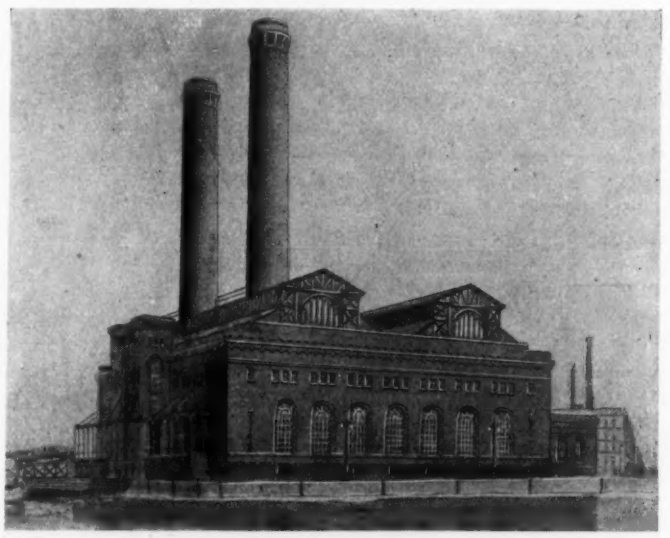


FIG. 4.—PORT MORRIS POWER STATION.

boards are enclosed in an operating booth constructed of steel and wire glass. Three field switchboard panels are located outside on each side of the operating booth. An alternating-current and a direct-current light and power switchboard on either end of the operating gallery complete the switchboard installation in the turbine room.

At both power stations switch houses have been provided, separate from the main building, with the idea of obtaining the best conditions for the installation of high-tension switching apparatus, and at the same time increasing the safety of operation. At Port Morris the switch house is 50 ft. 10 in. wide by 100 ft. long. At Yonkers the switch house and the sub-station for that district are combined in one building, 37 ft. 4 in. wide by 255 ft. 4 in. long; the

switch house occupies 147 ft. 8 in. of the length and the sub-station 107 ft. 8 in. In the switch houses are installed the high-tension switching equipment, consisting of bus-bars, oil switches, instrument transformers, etc.; also such instruments as are required for the complete equipment of generating stations, but which are not essential for the operator.

The switch house also contains auxiliary boards, which allow the main operating switchboard in the turbine room to be put out of service if it should be desirable for the purpose of cleaning and repairs. These boards will also permit the operation of the station should by an accident the main operating board become disabled.

Two high-tension buses, to which the generators are connected by means of a main switch and two selector switches, are installed in the basement of the switch houses. The feeders are equipped with selector switches only. Overload relays are installed in the generator and feeder circuits, but the generator relays will operate only under very extreme conditions. In the generator circuits, in addition to overload relays, reverse-current relays will be installed; these, however, are connected to indicating lamps only, not tripping the oil switches. All relays are of the inverse time limit, bellows type.

All high-tension connections and apparatus are located in the basement of the switch house, and no such apparatus is located on the first floor, except the oil switches, to which connections are made from the basement through the floor. The basement is made inaccessible to any but authorized workmen. This precaution and the removal of the high-tension apparatus from the power house itself into a confined space in a separate building reduce the danger of coming in contact with high-tension apparatus to a minimum.

On the second floor are located the load dispatcher's office, the exciter battery with booster and switchboard, laboratory, storeroom, toilet rooms and the apparatus for the hot-air heating and ventilating systems.

The arrangement of oil switches and connections is such that the apparatus belonging to one generator and three feeders form a unit which is entirely separated from the others by fire-proof walls in the basement. All connections between oil switches and bus-bars are made with bare copper tubing 1¼ in. outside diameter, the construction being such that practically no insulators will be required. The buses are enclosed in vertical brick and Alberene stone compartments, and all high-tension connections will be separated by brick or Alberene stone barriers. The oil switches can be disconnected from the high-tension system by means of knife switches located in the bottom of the oil switches accessible from the first floor. This arrangement prevents accidents which might be made by mistake in disconnecting switches from live parts. All cables coming through the duct system from the power house enter manholes in the basement of the switch house, and are so arranged that the high-tension cables enter the high-tension compartments entirely separated. Low-tension cables enter through manholes in a passage separated from the high-tension compartments by a fire-proof wall, and are brought up in enclosed chases in the wall, so that they are positively insured against any accidental connection with high-tension conductors. The oil switches have a rated capacity of 500 amp., except the bus-tie switches, which have a rating of 1,200 amp. The switches are of the General Electric motor-operated type, and have all recent improvements.

All high-tension cables and the majority of the single-conductor, low-tension cables are cambric-insulated and lead-covered. The insulation is 10-32 in. for high-tension cables and 4-32 in. for low-tension cables, with a lead cover 3-32 in. Multiple conductor cables for instrument and control wiring have a combined cambric and rubber insulation. Single conductor cables will be used for connecting the generators with the oil switches.

About 1,000 incandescent and thirty-six arc lamps will be required for lighting the Port Morris power station, and 1,000 incandescent and forty-two arc lamps for lighting the Yonkers power station. The amount of power required for operating auxiliary machinery equals 240 hp alternating current and 1880 hp direct current at Port Morris, and 260 hp alternating current and 180 hp direct current at the Yonkers power station.

The organization of the engineering department of the New York Central Railroad which has charge of the design and construction of the generating stations is as follows: At the head is Fifth Vice-President William J. Wilgus, and there are three principal departments: Electrification, construction and architecture. The first-mentioned comprises the Electric Traction Commission, consisting of Mr. Wilgus, chairman, J. F. Deems, Bion J. Arnold and Frank J. Sprague; Mr. Edwin B. Katte is electrical engineer of this branch, with the following staff: J. D. Keiley, assistant electrical engineer; C. Schwartz, assistant engineer, and E. L. Broome, assistant steam engineer. The second department—construction—is sub-divided into designs and execution. In the former are Messrs. G. A. Harwood and V. Spangenberg, designing engineers; Mr. C. P. Marsh, bridge engineer, and Mr. W. H. Elliott, signal engineer. In the latter, Mr. W. H. Knowlton is principal assistant engineer, with Mr. G. A. Berry as assistant, and Mr. A. B. Corthill as terminal engineer. The architectural design is placed with Messrs. Reed and Stern for Grand Central terminal and Warren and Wetmore for power and sub-stations, with Mr. Chas. A. Reed as executor. Among the contractors on the work are as follows: Turbo-generators and complete switching equipment, General Electric Company; exciter storage batteries, Electric Storage Battery Company; boilers, Babcock & Wilcox Company; piping, M. W. Kellogg & Company; valves, Best Manufacturing Company; chimneys, Alphons-Custodies Chimney Construction Company; condensers, Henry R. Worthington; feed-water heaters, Taunton Locomotive Manufacturing Company; boiler feed pumps, Epping-Carpenter Company; flues, B. F. Hart, Jr., & Company; coal and ash-handling apparatus, Exeter Machine Works; mechanical stokers, Westinghouse Machine Company; electrical traveling cranes, Alfred Box Company; light and power equipment, Thompson-Starrett Company.

Stone Wireless Telegraph Patents.

About a year ago 40 patents relating to wireless telegraphy were issued to Mr. John Stone Stone, and on October 24 a budget of 16 patents were issued to the same inventor, also dealing with space telegraphy, and containing a total of 129 claims.

On November 25, 1903, applications were filed for two patents relating to the transmitter of a system of selective electric signaling, which employs a method of increasing the amplitude of the oscillations developed by the sonorous circuit, and of increasing the persistency of these oscillations. In addition to the usual closed circuit connecting the spark-gap with the primary of the step-up transformer through an isolated inductance coil and a condenser, there is a second sonorous circuit in parallel to the spark-gap and containing a separate condenser and an inductance coil. Each of these sonorous circuits is adjusted to the natural frequency of the vertical radiating conductor. On February 23, 1904, applications

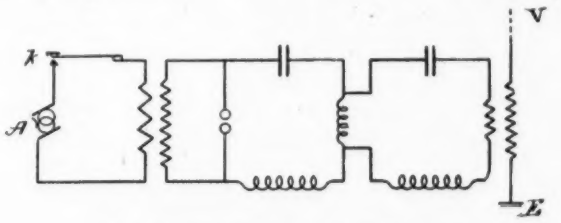


FIG. I.—TRANSMITTER CIRCUITS.

were filed for two patents relating to receivers for selective wireless telegraphy. According to these patents, the receiving conductor is attuned to the frequency of the waves, the energy of which is to be received, while the receiving circuit which is associated therewith is likewise attuned to the same frequency, and a third resonant circuit is also inductively associated with the receiving conductor. This disposition of the circuits is adopted in order to prevent the receiving system from responding to extraneous electrical impulses of improper frequency. Two additional patents issued on applications filed February 23, 1904, refer to receiver circuits which differ from those just described in that the receiver circuit is conductively, and not inductively, connected to the receiver conductor.

Fig. 1 shows transmitting circuits, application for the patent of which was filed on December 16, 1904. The elevated conductor system is inductively associated with a resonant circuit which is conductively connected to a sonorous circuit which is adapted to develop electrical oscillations of a definite frequency.

A patent issued on an application filed March 31, 1905, relates to syntonic receiving circuits. The elevated receiving conductor is adapted to present a definite reactance for the frequency of the waves, the energy of which is to be received. To this conductor is conductively connected a parallel branch circuit containing capacity

in one branch and inductance in the other, so proportioned as to present for a persistent train of electrical oscillations of the chosen frequency a reactance equal and opposite to that of the elevated conductor considered alone. The wave detector is conductively associated with one of the parallel branches.

On May 4, 1904, four applications were filed for patents dealing with apparatus for the receiving stations. Two of these patents refer to modifications of the patent just described, while the other two treat of receiving apparatus composed of an elevated conductor to the lower end of which is connected an electrical system consisting of a plurality of coils and condensers having for the wave lengths employed such capacity and inductance that the reactance

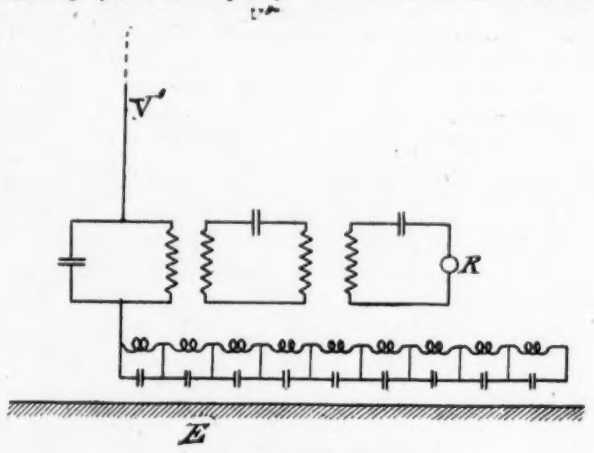


FIG. 2.—RECEIVER CIRCUITS.

of the system for the corresponding frequencies is equal to that of the elevated conductor. (See Fig. 2.)

A multiplex system of space telegraphy, in which the transmitting stations may selectively transmit their signals, each to a particular receiving station simultaneously without interference, is disclosed in two patents for which applications were filed May 10, 1905. There is associated with the elevated conductor a plurality of persistently oscillating circuits attuned respectively to different definite frequencies, and separate circuits likewise associated with the elevated conductor and containing such capacity and inductance as to render the reactance of the elevated conductor system as a whole zero for persistent trains of oscillations of the desired definite frequencies.

Fig. 3 shows a method of increasing the amount of energy that

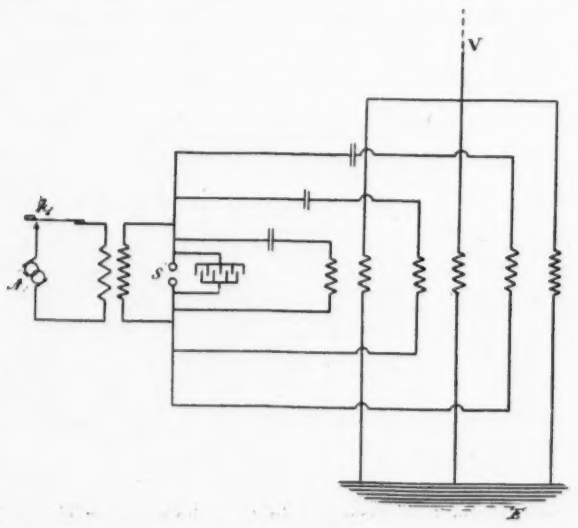


FIG. 3.—TRANSMITTER WITH PLURALITY OF SONOROUS CIRCUITS.

may be radiated in the form of simple harmonic electromagnetic waves, as disclosed in two patents for which applications were filed June 20, 1905. Each of the sonorous circuits is adapted to develop simple harmonic electrical oscillations of the same definite frequency, and all are connected in parallel to a common spark-gap, the radiating conductor being inductively associated with all of the sonorous circuits, as indicated in the diagram.

On October 31 the same inventor obtained two additional patents, the applications for which were filed June 20, 1905. These patents relate to wireless telephony. With a transmitting conductor there is associated a sonorous circuit which is adopted to develop a substantially continuous train of electrical oscillations of substantially constant amplitude. The amplitude of these waves is modified in accordance with the vibrations of air accompanying vocal sounds. A variable-resistance type telephone transmitter is connected in a locally-closed circuit which contains a reactance coil and a condenser and which is inductively associated with the sonorous circuit. A change in the resistance of the transmitter, due to vocal sounds, produces a corresponding change in the constants of the sonorous circuits, and thereby alters the amplitude and frequency of the oscillation in the transmitting aerial. At the receiving station a telephone receiver is connected in a local circuit which contains a battery and which is joined in parallel with a wireless receiver of the bolometer type.

The frequency of the simple harmonic electrical oscillations developed in the radiating conductor by the continuously oscillating circuits, is, of course, far above the limit of audibility, but by the means described such oscillations have their amplitude modified in accordance with the sound waves which affect the transmitter, and, accordingly, there results the radiation of a continuous train of electromagnetic waves having its amplitude correspondingly modified. Such continuous train of high-frequency simple harmonic electromagnetic waves, whose amplitude is so modified by the slower periodic vibrations of the frequency corresponding to the pitch of an audible tone or combination of tones, develops oscillatory electric currents of corresponding frequency and modified amplitude by impinging upon an elevated receiving conductor at a distant station. Such surrents so developed in the elevator receiving conductor system are selectively absorbed by the resonant receiving circuits, attuned to the frequency of such currents.

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES.

Metallic sodium is made commercially at Niagara Falls by the Castner process which electrolyzes caustic soda in a single cell. A patent recently granted to E. A. Ashcroft proposes the use of a double-cell which, in some respects, resembles the Castner-Kellner and the Acker cells for electrolysis of sodium chloride. As in the Castner-Kellner process, Ashcroft uses an intermediate bipolar electrode which forms the connection between the two cells; but he electrolyzes fused salt and, therefore, cannot use mercury for the bipolar electrode, but uses instead fused lead, as is done in the Acker process. In this first compartment Ashcroft electrolyzes fused sodium chloride. The sodium set free by the cathodic reaction alloys with the fused lead and is transferred into the second compartment where it passes again into the electrolyte which is fused caustic soda. In this cell metallic sodium is then obtained as a cathodic product.

Another process in which a fused electrolyte is employed, is described in a patent of H. S. Blackmore. It may be best described in its application to the production of a copper-aluminum alloy. Copper aluminate is dissolved in a fused mixture of lithium and calcium oxides, and on electrolysis of this fused solution, a copper-aluminum alloy is obtained.

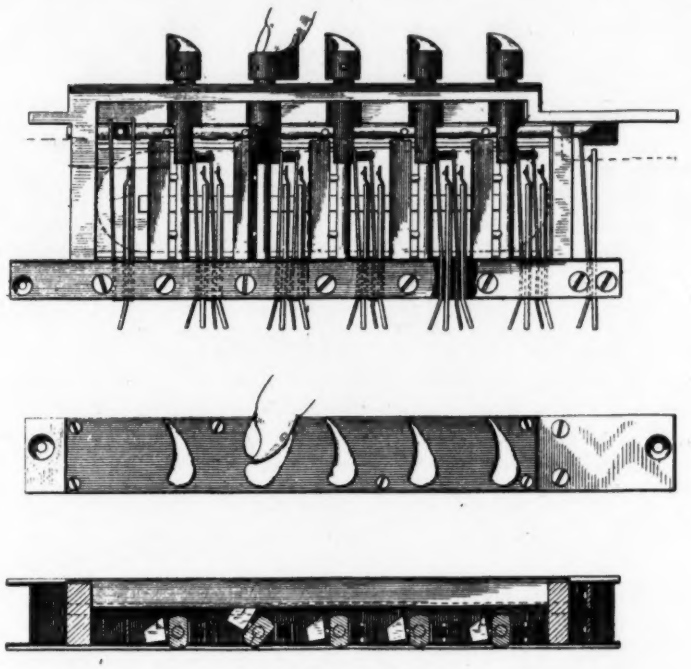
In all metallurgical processes, metals are purified by means of slags which combine with the impurities and thus remove them from the metallic bath. A modification of this method is proposed in a recent patent of H. M. Chance, who holds the metal in molten state in contact with an electrolyte which on electrolysis yields the purifying agent. Thus he proposes to purify molten iron by making it a cathode, in contact with fused calcium chloride as electrolyte; calcium is then set free by the current and serves as a purifying agent.

Chlorates are made commercially by electrolysis of aqueous solutions of the chlorides in a cell without a diaphragm at a temperature of about 70° C.; this process is in use by the National Electrolytic Company, at Niagara Falls. A process recently patented by A. E. Gibbs yields simultaneously chlorate and bichromate. It depends upon the reaction between chromate and chlorine gas, yielding bichromate, chlorate and chloride. Either a stream of chlorine gas from a reservoir is pumped through a solution of chromate, or the chlorine is electrolytically formed in the cell itself. In the latter case the cell contains both chromate and chloride, and a diaphragm cell is employed.

New Telephone Patents.

CENTRAL OFFICE APPLIANCES.

In the cut is shown a machine ringer for selective party line work. Such a key can be used to advantage upon the incoming end of trunks operated upon the calling circuit basis. It will be seen that a cam upon a rotating shaft drives the individual signal current springs, as well as oscillates the longitudinal bar associated with the switching contacts. As any shaft is rotated a soft-iron armature



MACHINE RINGER.

bar attached to it is thrown against the poles of an electromagnet, which forms a part of the key, and as long as the magnet is energized the key remains thrown. The current is, of course, cut off the magnet by some auxiliary device. F. H. Loveridge is the inventor of this key, he having assigned his patent to the Western Electric Company.

Georg Deisenhofer, of Germany, has patented a main distributing frame, the terminal bars of which are arranged in pairs, the two bars of a pair being close together. This saves in the length of a frame by the saving of one-half the clear space usually required for working on cross-connections.

The so-called horizontal type switchboard is almost obsolete in this country, and thus a multiple cable hanger for such a switchboard, patented by G. Lambert, of Charlottenberg, Germany, is of but slight interest. This hanger consists of a series of loops of webbing, each of the proper length to hang the cable to correspond with its jack strip.

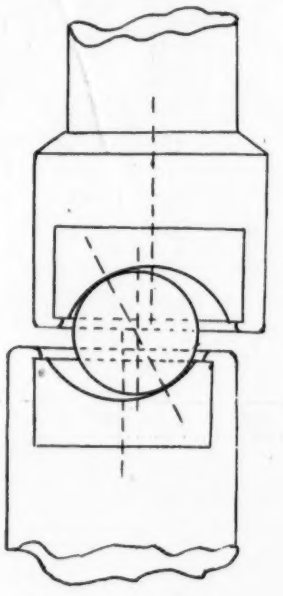
LETTER TO THE EDITORS.

"How Can the Ball Roll?"

To the Editors of Electrical World and Engineer:

SIRS:—The communication in your issue of October 21, entitled "How can the ball roll?" by Prof. Hallock, reminds the writer forcibly of the old tale of one Christopher Columbus, and the egg.

The solution in this case is equally simple: The balls and the jewels are not absolutely perfect, thus causing a slight motion of the ball; there is also a displacement of the axis of the moving



BALL AND BEARINGS.

element caused by the torques of the magnets. The sketch herewith shows the position taken by the ball when there is a load on the meter. It will be seen that the ball will roll, describing an irregular path which will vary with changes in load, vibration, and other disturbing elements, thus constantly presenting new surfaces of contact.

WILKINSBURG, PA. PAUL MACGAHAN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Converters.—CORSEPIUS.—In an article on electrical exhibits in the Exposition at Liege, a new type of converter is mentioned, the so-called "permutatrice" of Rouge-Faget, built by the Societe Anonyme Egyptienne d'Electricite. This machine has a vertical axle, and when producing current, no other portion revolves except the axle and the brushes. The commutator, which is at the top of the machine, is stationary. A diagram of the machine is shown in Fig. 1. The explanation given of the action of the machine is not very clear, and is as follows: "A motor generator consists of two separate machines, hence there are two magnetic fields independent of each other. If these two fields are united in a synchronous machine for the purpose of transforming three-phase currents into direct-current the ordinary rotary converter is obtained. If the two fields are united in a non-synchronous machine for the same purpose, the permutatrice is obtained." According to the inventor, "the synchronous displacement in the machine serves simply for utilizing the electromotive force in form of direct-current, without having any inductive effect. The practical result is that converters never weigh less than 33 kilogram per kilowatt, while the permutatrice weighs 20 kg for small machines and 15 kg for large machines (over 30 kw)." The stator of a non-synchronous motor is wound as a direct-current armature and is provided with a commutator. The lines of magnetic flux pass through the inner space and complete the magnetic circuit partly in the stator and partly in the rotor. The rotor runs synchronously as a result of the introduction of a direct current, which is taken as a part from the current produced by the machine. The bridge of the brushes also runs synchronously, so that direct current can be taken from two slip rings connected to the brushes. "The position of the brushes in the permutatrice influences the wattless current, which is taken from the network. The direct-current voltage changes according to the cosine of the angle of displacement of the brushes. The reaction of the energy component of the three-phase currents and that of the direct current upon the magnetic field do not compensate each other at all points of the circumference. The magnetizing action of the three-phase currents is proportional to the sine of that angle while that of the direct current changes from a fixed positive to a fixed negative value. There is, therefore, an imperfect transformer action on account of a stray field. This may be counteracted

by very strong saturation in the teeth, which, however, has certain disadvantages." The inventor uses another device in which a winding is placed on the stator in such a way that a sinusoidal distribution of the ampere turns on the interior circumference results. A 300-kw machine requires a foundation space of 2.25 square meters (24 square feet). Special attention has been paid to the brush construction. Tests of an 8-kw machine have given the following results. The power factor is 0.9 and increases to 0.93 when the machine is overloaded. The efficiency is a maximum (80 per cent) at normal load. A 25-kw machine has a power factor of 0.9 and an efficiency of 0.88, a 150-kw machine a power factor of 0.96 and an efficiency of 0.93. The chief application of the new machine is said to be

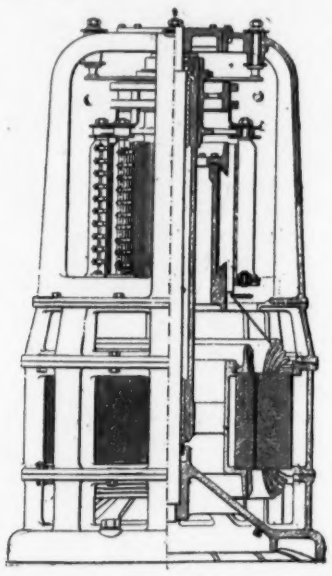
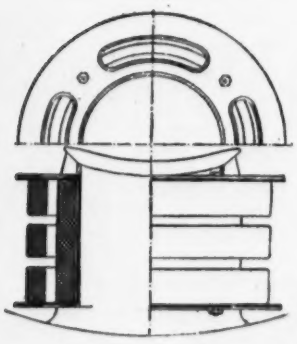
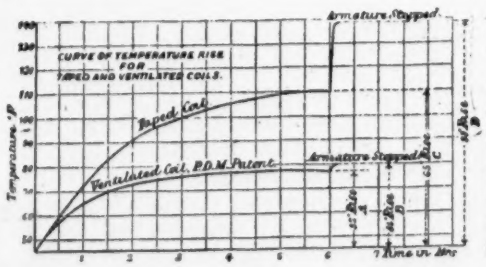


FIG. 1.—SECTIONAL ELEVATIONS OF CONVERTER.

for converting alternating current into direct current for traction, and it is emphasized that this machine is suitable for small capacities and, therefore, for a large number of converter stations of, say, 100 kw. It is started in a simple way by closing the primary switch. A 150-kw permutatrice runs up to synchronism in three seconds.—*Elek. Zeit.*, October 12.

Converter.—REYVAL.—An illustrated description of the "cascade converter" of the Arnold system. This machine consists essentially of an ordinary induction motor, the rotor of which is keyed to the shaft of a rotary converter. The cascade converter of this type, which was exhibited in Liege, as described on page 698 of our issue for October 21, 1905, is treated at great length, and its design dimensions are given in detail. It is stated that for three-wire distribution the cascade converter possesses an exceptionally advantageous feature in that it is sufficient to connect the external





FIGS. 2 AND 3.—DIRECT-CURRENT DYNAMO.

wires to the positive and negative bus-bars and the neutral wire to the neutral point of the rotor. In this case the converter acts also as a compensator. The automatic regulation thus obtained is so efficient that with one-half of the system loaded and the other half open the difference between the voltages of the two halves is not more than three per cent.—*L'Eclairage Elec.*, October 7.

Direct-Current Dynamo.—In the report on exhibits at the Olympia Exposition in London, direct-current machines built by the Phoenix Dynamo Co., are described in which commutation poles are used, as was noticed previously in the Digest. The peculiarity of the commutation poles in this case is that their faces decrease in breadth in the direction of motion for the purpose of equalizing the field. It is stated that a 3.5-hp shunt-wound motor fitted with auxiliary poles was varied in speed from 470 to 2,400 revolutions per minute by field control. It took 22 amperes at 220 volts and showed no signs of sparking at any speed. In order to improve the ventilation the field coils are provided with ducts, as shown in Fig. 2. The effect of radiation is clearly shown by the curves in Fig. 3. In the ordinary coil the external temperature rose to about double that of the ventilated coil on the same machine; while after the machine was stopped and the air blast consequently absent, the ordinary coil rose very much higher again showing that its internal temperature was far greater than that of the other.—Lond. *Elec.*, October 20.

LIGHTS AND LIGHTING.

Street Lighting.—Some figures on the comparative cost of electric light and gas for street lighting. S. L. Pearce, of the Manchester central station, gives some comparative figures as to the cost of gas and electricity and the relative amount of light obtained in commercial use in a street in Gorton. His figures show that with electric light 75 per cent more illumination was obtained for an 18 per cent increase in price compared with incandescent gas lighting. He then gives some figures for lighting Fleet Street by flame arcs either by short-hour lamps (16 hours) or by long-hour lamps (45 hours). He concludes with the following comparative figures showing the selling costs of different systems of illumination for 1,000 effective cp-hours per year with electricity at 3 cents per kw-hour:

Flame arcs (long hour)	1.025
Flame arcs (short hour)	1.35
Ordinary carbons, single enclosure, long hour (Manchester)	1.6
Fleet Street (incandescent gas)	2.4

Some figures are also given from London practice and the subject is discussed in a long editorial, in which it is emphasized that in spite of the recent improvements in connection with the incandescent gas mantle, street lighting by electricity remains far cheaper than street lighting by gas.—Lond. *Elec.*, October 20.

Selection of Incandescent Lamps.—DAWSON.—The author points out that the real root of the problem of the most suitable lamp to use consists not simply in the ascertaining of the most efficient or the cheapest lamp on the market per se, but in the obtaining of candle-power-hours at the lowest total costs, and one of the most important determining factors in deciding this, one which is only too often completely overlooked, is the cost of electrical energy with which the lamp or lamps are to be supplied. In cases where electrical energy is cheap, the efficiency of the lamp is not such an important factor as the life and the cost of the lamp renewals, and conversely in cases where electrical energy is dear, the efficiency of the lamp is the most important item, and that of life and cost of lamp renewals are only of secondary importance. The relative values of the various items composing the total cost per cp-hour are set forth in the following formula: Total cost per cp-hour =

$$\frac{\text{cost of lamp in cents}}{\text{life in hours} \times \text{average cp}} + \text{average watts per cp} \times \text{cost in cents}$$

of 1 watt-hour of electrical energy. A serious difficulty in the application of this formula is that several factors in it can be ascertained only by means of extended tests under actual working conditions. The author suggests that central stations should institute a careful and systematic testing of various makes of lamps on the market for candle-power, current and life.—Lond. *Elec. Rev.*, October 13.

Alternating-Current Arc.—SIMON.—An account of an experimental investigation of the relation between current and voltage in the alternating-current arc. The author has determined what he calls the dynamic characteristic, taking simultaneous instantaneous values of voltage and current when the current is varying periodically. It appears that the principal determining factor for the voltage required for a given current is the product of the temperature and surface of the negative crater. It is immaterial how the value of this product is produced, that is, whether the necessary temperature is produced by the current itself or through externally applied heat.—*Elek. Zeit.*, August 31 and September 7; an English translation in abstract in Lond. *Elec. Eng.*, October 20.

POWER.

Gas Producers.—RICHARDS.—In a continuation of his serial on metallurgical calculations the author takes up the subject of producers for making artificial furnace gas and deals in the present installment with simple producers, that is, those which use ordinary fuels, such as wood, peat, lignite, bituminous coal or anthracite, and in which no water or water vapor is introduced other than the water in the fuel itself, and the normal moisture of the air used. The calculations which are of immediate interest to make, and the results of which are of immediate value to the metallurgist are those concerned with the volume of gas produced per unit of fuel, its calorific power compared to that of the fuel from which it is produced, the items of the heat losses during the operation of transforming the solid fuel into gaseous fuel, the function of steam in the producer, the limits up to which the use of steam is permissible, the increase of efficiency of the gas by subsequently drying it, and the advantages as to final efficiency which are gained by gasifying the fuel over burning solid fuel directly. Several numerical examples are given.—*Electrochem. and Met. Ind.*, November.

Producer Gas.—An illustrated article on a small producer gas plant which has been in successful operation with soft coal for nearly two years in Indiana. The electric equipment consists of a 75-kw, 250-volt generator and nine motors.—*Eng'ing Record,* October 28.

Modern Power Plant Design.—KOESTER.—The conclusion of his well-illustrated serial on modern power plant design and economics. In the present installment he deals with the electric equipment of the generating room. Modern practice tends toward the general adoption of electrically-driven auxiliaries, viz., water and air pumps, exciter sets, etc. Individual electric-motor drive for the machinery of the boiler house, such as coal and ash-handling apparatus, stokers, draught fans and economizers, scrapers, etc., has long been recognized to be the best practice. When the individual motor-drive system is adopted, a storage battery should always be installed to supply power in case of a breakdown (the cause of which may be either inside the plant itself or outside on the line) unless the auxiliary generator is steam-driven and the circuit is kept an entirely distinct system from the main line. The battery is also desirable during a heavy load for maintaining a steady voltage on the exciter bus-bars. As the storage battery is often employed for the operation of the automatic switches, it preferably should be installed of sufficient capacity to supply power in case of emergency. Although cost of installation and maintenance is great, the storage battery is usually a paying investment—depending, of course, on the type of service. The author then discusses at some length the arrangement of the switchboard.—*Eng'ing Mag.*, November.

Power Plant of Department Store.—A long illustrated description of the power plant of the new Wanamaker store in Philadelphia. The electric equipment will consist of four 500-kw and six 175-kw steam-driven generators, operating on the three-wire system with the lights on the 115-volt circuits, and the power taken from the 230-volt combination.—*Eng'ing Record,* October 28.

Electric Hoist.—GUARINI.—An illustrated description of an electric hoist installed at the Tiremande colliery in Belgium with a novel arrangement in which the hoist is placed at the top of the head frame.—*Mines and Minerals,* October.

Steam Boilers.—WATSON.—A discussion of steam boilers of the past and present with illustrations of the principal types.—*Eng'ing Mag.*, November.

TRACTION.

New York Central-New Haven Situation.—TOWNLEY, BELL, BOYNTON.—Three letters in reply to the article of Sprague who criticised severely the decision of the New Haven road to use a single-phase locomotive and made a plea in favor of direct-current multiple-unit trains The present three authors defend the decision of the New Haven road. Bells says it looks as though this railroad in this latest move, sensational though it be, is building, not for the terminal service, which will soon be inaugurated, but for the far larger work to which the carefully worked out third-rail, direct-current system is not even the prelude. If the single-phase locomotive is successful, "then a problem of engineering infinitely greater than even the New York terminal system will have been solved, and the way will be open for very great changes. In short, I do not think it a sound conclusion to assume that the New York, New Haven and Hartford Railroad has recklessly butted into a huge experiment at the peril of its passenger service merely for the sake of its trains to Stamford. It is after larger game, and game that cannot be brought to bay by any weapon yet discovered in the direct-current armory. If the experimental stage is safely passed with the alternating-current locomotives, then the question will be, not how conveniently they can be accommodated by the existing direct-current terminal system, but how long that system can keep up under the new conditions without accommodating its equipment to modern improvements." "It must be granted even from the standpoint of conservatism, that if the alternating-current locomotive makes a success in heavy traction it will have a wider field of usefulness in big work than can be hoped for by 500-volt or 600-volt or 800-volt direct-current motors, tied up as they are to the third-rail scheme of feeding. As it is, the railroad wins much if the experiment succeeds and loses little if it fails."—*St. R'y. Jour.*, October 28.

High-Tension Direct-Current Traction in Vienna.—BOEHM-RAFFAY.—Between the stations Praterstern to Hauptzellamt, of the Vienna city railroad (which is operated at present with steam), a trial will be made with the direct-current three-wire system, the rails forming the middle wire and two trolley wires the outers. The voltage will be 2 x 1,500. The installation is made by the firm of Krizik. The experimental road is only 1.4 kilometer long. The four 200-hp motors of the locomotive are either connected all in series or in two groups of two in parallel. The central point of the set of motors is connected to earth through the rails. The load on the two outers or the two halves of the three-wire system is, therefore, exactly balanced so that the running rails are without current or carry only a very weak current. The trolley wires are suspended by means of side poles and span wires, each trolley wire being placed perpendicularly over one rail, in order to prevent trouble from the smoke of the steam locomotive. An electric locomotive of 800 hp will be used, containing four motors each of 200 hp. The voltage of 2 x 1,500 is used only on the line between the stations while in the stations themselves where lower speed is used, the motors are connected between one outer and the rails so that the voltage is only 1,500.—*Elek. Anz.*, October 15.

High Speed Traction Tests.—A long report illustrated by many diagrams on the results of the Berlin-Zossen tests of 1902 with respect to the air resistance and its relation to the shape of the car and the other resistances to the train movement.—*St. R'y. Jour.*, October 28.

Steel for Motor Cars.—GUILLET.—An illustrated paper discussing the different steels used in France in the actual construction of motor cars. These special steels are classified as follows: 1. Steels with low percentages of carbon and nickel (pearlite steels) which are used for parts which require cementing and quenching—i. e., shafts, gears which engage directly, etc. 2. Steels with medium percentages of carbon and low percentages of nickel, used after quenching and reheating, for a large number of parts, shafts, gearing, pinions, etc. 3. Steels low in carbon and with high percentages of nickel, used for valves. 4. Chromium steels, with high carbon and low chromium percentages, used for bearings. 5. Silicon steels, used for springs and for gearing. 6. Nickel-chromium steels, with low percentages of nickel and of chromium, employed for numerous parts requiring resistance to shock, and a certain degree of hardness. 7. A steel known as "N. Y." the composition of which has not been published.—Lond. *Eng'ing,* October 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Liquid Controller.—An illustrated description of a liquid controller exhibited at the Olympia Exposition in London by Steel, Peech and Tozer. This controller, which is shown in Figs. 4 and 5, combines a circuit-breaking and direction-reversing arrangement with a regulating resistance. It consists essentially of a tank, *K*, in its lower part, which contains the resistance liquid. In this dips a contact plate, *O*, which can be lowered into or raised out of the liquid by means of a shaft, *R*, which works in a roller bearing arrangement, *P*. At its upper end the shaft, *C*, is provided with a roller, *Q*, which works in a slot, *S*, of peculiar form, made in the cylindrically-shaped portion, *T*, which can be revolved by means of the vertical spindle and the hand wheel, *H*. Owing to the form of the slot, *S*, the plate, *O*, which is shown in its highest position, and clear of the liquid, will be lowered, if the hand wheel is revolved either to the right or left hand, these motions determining the direction of rotation of the motor to which the switch is connected. Just above the liquid in the tank will be observed curved overhanging plates, *N*, cast solid with the tank itself. These are to prevent splashing,

should the switch be mounted on machinery subject to motion. Underneath the hand wheel is a box which has an insulating base of slate. On this base and concentric with the spindle, *H*, are three metallic contact rings, *L*, *M* and *N*. The inside and outside rings, *L* and *N*, are complete, but the middle ring, *M*, is broken in two places,

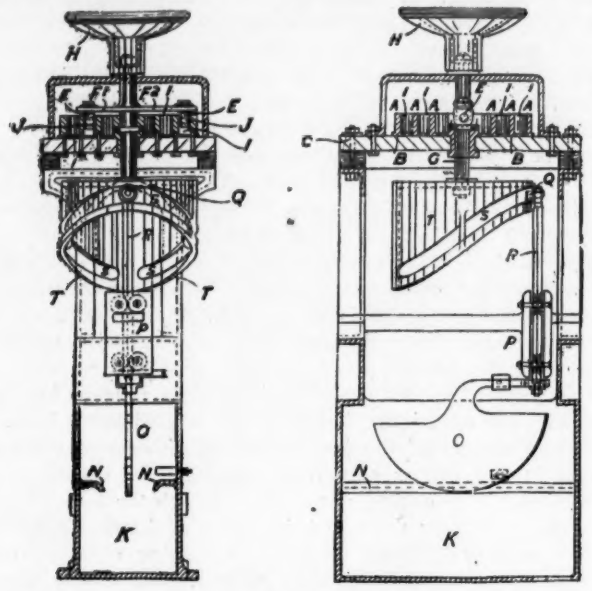


FIG. 4.—LIQUID CONTROLLER.

the space between the two halves of the ring being filled up with an insulation material worked up level with the surface of the metal. Attached to the spindle, *G*, is a bar of insulating material, having arms of unequal length. This is revolved when the hand-wheel is turned, and it carries two contact pieces, *K* and *K'*, the first of which revolves in the space between the rings, *M* and *N*, while the second revolves in between *L* and *M*. Both contact pieces are provided with a spring, which ensures electric contact between those rings which it is desired to connect together. The positive terminal of the generator supplying current to the motor is connected to the ring, *L*. One-half of the ring, *M*, is connected to one

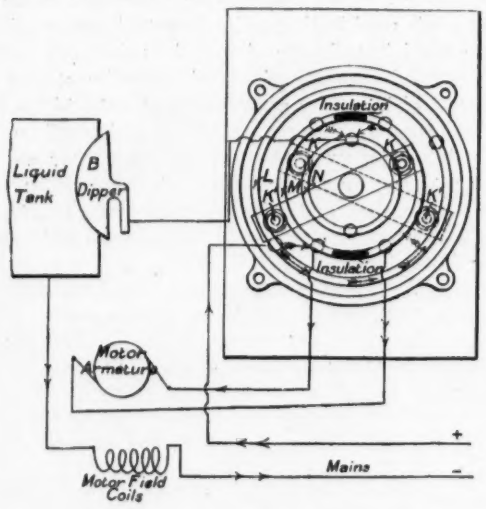


FIG. 5.—LIQUID CONTROLLER.

terminal of the motor and the other half to the other terminal, while the ring, *N*, is connected to the dipping plate, *O*. The tank, and hence the liquid, is connected to one terminal of the motor fields, the other field terminal being connected to the negative main. Suppose, now, the contact arm to be in the position shown by the full lines, then the ring, *L*, is in electric contact with the left-hand half of the ring, *M*, and the ring, *N*, is in contact with the right half of *M* by reason of the contact pieces, *K* and *K'*, as already explained. In this position the current from the positive main travels from the ring, *L*, through the contact piece, *K*, to the left-hand half of the ring, *M*. From there it goes direct to the right-hand motor brush. The left-hand motor brush is connected, as already mentioned, to the right-hand half of the ring, *M*. The current, therefore, flows to this, and thence by the contact piece, *K*, and the ring, *N*, to the dipper, *O*, the liquid tank and the motor field to the negative main. This disposition of the apparatus would cause the motor to revolve in one direction. If it is desired to reverse the direction or rotation, the arm, F^1F^2 is moved to the position shown by the dotted lines. The current would then travel by way of the ring, *L*, the contact piece, *K'*, and the right-hand portion of the ring, *M*, to the left-hand terminal of the motor, thus passing through the armature in the reverse direction, and flowing away by the left-hand portion of the ring, *M*, the contact piece, *K*, the ring, *N*, to the negative main, through the liquid tank and the motor field. The direction of the current in the field is, therefore, the same in either case, and only the direction through the armature is changed.— Lond. *Elec.*, October 13.

Choice of Supply Voltage for New Stations.—WIKANDER.—In 1897 Germany began to follow the English fad of raising the supply voltage of direct-current three-wire systems from 2 x 110 to 2 x 220 volts. In recent years, however, the situation is no longer so favorable to the higher voltage. There are now several new lamps like the tantalum and the osmium lamps for which an e.m.f. of 220 volts is not suitable. The Bremer arc lamps cannot be made for high voltages, and if the voltage is 220, at least four of them must be connected in series, which greatly reduces their field of usefulness. Only the Nernst lamp is suitable for 220 volts, but this voltage is available also between the outers of a 2 x 110 system. Moreover, carbon-filament incandescent lamp for 220 volts have now been recognized to be much inferior to 110-volt lamps. "For instance, new 16-cp lamps consume at 220 volts about 3.75 watt per candle against 3.1 to 3.5 watt at 110 volts, but the candle-power of the former decreases much more quickly, so that the average consumption of power per candle is at least 15 or 20 per cent higher." The author concluded that under these circumstances the supply at 2 x 110 or 2 x 120 volts represents at present the best practice. Against this system the objection has sometimes been raised that it is desirable to be able to furnish from the lighting dynamos, current at 500 to 600 volts for traction. To accomplish this, each prime mover is to be coupled with two 220-volt dynamos, which are connected in series for traction. Such double machines are a little more expensive than simple machines and require a more complicated switching arrangement, but they have certain advantages. For instance, a street railway conduit may be operated with +300 volts in the one conductor and —300 volts in the other conductor. The double machines are reliable in operation and have the advantage for lighting that one is able to give current even if the other one is out of order. The author then discusses the advantage of a neutral wire in alternating-current networks. All the advantages of a high-secondary voltage can be retained and nevertheless a voltage of 110 to 120 volts be used at the lamps, if the secondary network is built with an earthed neutral wire. With single-phase current three-conductor cables and with the three-phase system four-conductor cables are to be used. The neutral wire is to be earthed at one point in the middle of the network. The advantages of this method are discussed.—*Elek. Zeit.*, October 12.

ELECTROPHYSICS AND MAGNETISM.

The Relation Between Dielectric Constant of Air and Density.—OCCHIALINI.—An account of experiments in which the author studied the variation of the dielectric constant of air with increasing pressure up to 200 atmospheres. The method was based on the comparison of two condensers, one of which contained air of varying pressure as dielectric. The results are given in the following table:

K	D	x	n^2
1.0101	20	169 x 10—6	1.0116
1.0196	40	162 x 10—6	1.0237
1.0294	60	162 x 10—6	1.0357
1.0387	80	159 x 10—6	1.0477
1.0482	100	158 x 10—6	1.0601
1.0579	120	158 x 10—6	1.0721
1.0674	140	157 x 10—6	1.0845
1.0760	160	154 x 10—6	1.0971
1.0845	180	152 x 10—6	1.1092

In the first column the dielectric constant, *K*, is given, in the second column density, *D*, in the third column the value

$$x = \frac{1}{D}\,\frac{K-1}{K+2},$$

which should be constant, according to the theory of Mossotti. It will be seen that this value is not constant, but decreases gradually

with increasing pressure. The last column contains the square of the refractive index. Since it refers to a wave length of the visible spectrum it cannot be exactly equal to the dielectric constant. The difference between K and n^2 represents the dispersion which increases with the density of the medium. If Mossotti's formula is considered as approximately correct in the form $x = 0.00016$, then it is possible to calculate from this formula the dielectric constant of liquid air. If the density of the latter compared with air is 871 one finds $K = 1.475$ which agrees pretty well with the value of Dewar, which was 1.495.—*Phys. Zeit.,* October 15.

Point Discharges in Pure Gases.—EWERS.—An account of a long investigation of the point discharge in monatomic and diatomic gases under conditions likely to secure the greatest attainable purity. The gases examined were helium and argon as monatomic specimens, and hydrogen and nitrogen as representatives of the diatomic class. The author is able to extend Roentgen's law to monatomic gases, and to state that the product of the minimum potential and the square root of the mean free path, divided by the root of the number of atoms in the molecule, is nearly the same for all gases under standard conditions. He finally arrives at the simple rule that for various barometric pressures and for any given e.m.f. the current through the gas is simply proportional to the mean free path of the molecules, a rule which allies gaseous conduction to metallic conduction on substituting electrons for molecules.—Lond. *Elec.,* October 13; from *Ann. d. Physik,* No. 10.

The Problem of Secret Telephony.

BY EDWARD P. THOMPSON.

If first class or sealed mail matter were abolished, and if people were obliged to correspond by open letters or postal cards only, all mail matter thus being open to inspection by those through whose hands it passed, it seems evident that both business and social intercourse by correspondence would be seriously crippled. The postal revenue would be reduced also. The public would object to the fact that all their correspondence could be read by post office employees. As a somewhat parallel case, telephone engineers have always known, but subscribers are only becoming aware, that present telephonic communications are no more private than postal card messages. The objectionable abuses of the operator's power to "listen in," being known, telephone business men, engineers and inventors have taken steps to remedy the deficiency.

Telephone users, in general, experience inconvenience and annoyance resulting from operators listening in. In some instances communication is seriously impaired. For example, the private branch exchange operator in a business office can become familiar, by listening in, with the most confidential affairs of the firm. Again, much of the private life of those in modern apartments is an open book to the girl who sits at the foot of the stairs.

The National Inter-State Telephone Association, at the June convention, agreed that "On modern systems, no listening whatever is necessary," and formulated a rule against listening. This quotation is from their Standard Operating Rules.

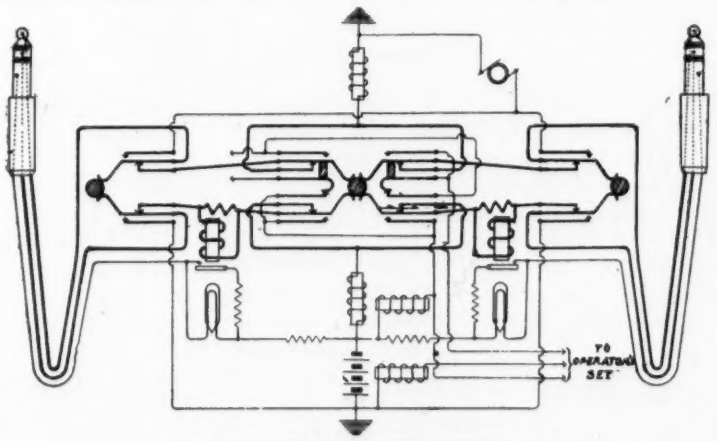


FIG. 1.—DIAGRAM OF CORD CIRCUITS.

Mr. W. Napier, at a recent meeting of the British Institution of Electrical Engineers, in commenting upon similar views of Mr. Herbert Laws Webb in a paper read before the society, approved the latter's remarks by observing that the necessity of listening in on the part of the operator is obviated. To make rules and to show that listening in is not necessary, proves that such listening is objectionable (perhaps as much so as are open letters by mail), but do not prove that the evil is thereby remedied.

Richard M. Beard, chief engineer and vice-president of the International District Telephone Company of New York, is becoming well known through his success in demonstrating that through the adoption of a few simple expedients, listening in by the operators may be absolutely prevented without detrimental effects in the handling of the traffic. That he has completely solved the problem is established by the sixty-seven claims allowed or granted to him by the Patent Office. One of the broader claims reads as follows: "Listening keys, an operator's circuit normally connected to said keys, and means automatically preventing more than one said listening key being connected to said circuit in listening phase at a time."

Telephone men especially, may be interested in an exposition of the practical construction for carrying out this generic conception, which could be practiced in various ways, all of which, however, if done by others, would constitute infringement. The particular manner in which Mr. Beard has constructed plants when applied either

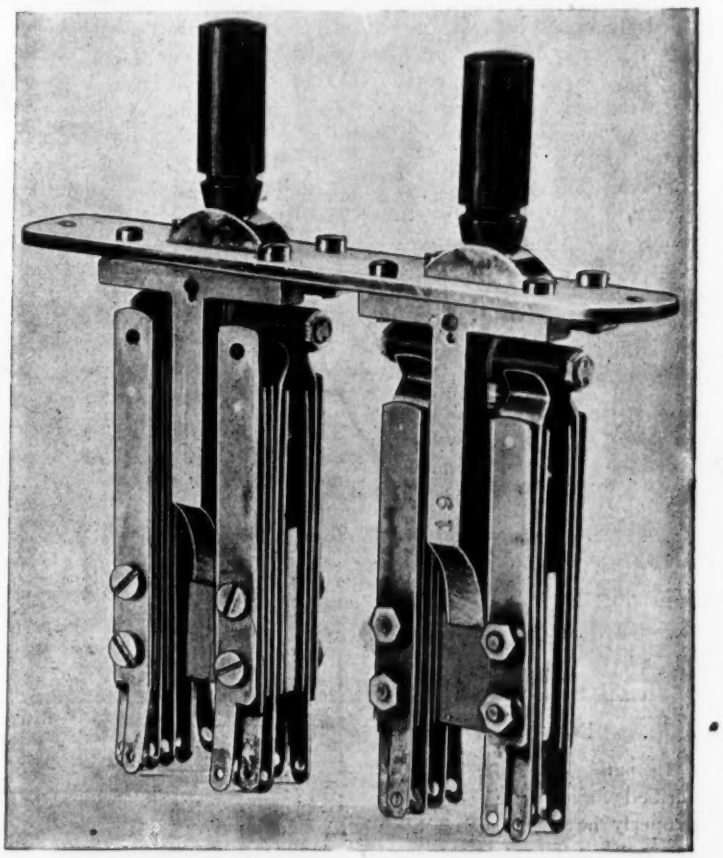


FIG. 2.—TWO-WAY LISTENING AND TWO-WAY RINGING KEY.

to a cord or cordless switchboard, comprises the old elements of an exchange together with the usual listening keys, each having a pair of contacts normally open to the respective subscriber's lines, and an operator's circuit to which said contacts are multipled, the listening keys having spring contacts preventing said open contacts of any key from being connected to more than one of said subscriber's lines at a time. All the installations in the world, therefore, could be transformed into secret systems, simply by incorporating a few extra contacts in the right places in the listening keys.

The cord circuit in the accompanying diagram, Fig. 1, shows the usual arrangement of lamp supervisory signals and a well known method of connecting to common battery. It is not claimed that this is the only arrangement or even the best, but one of the many ways of applying this circuit in common battery exchanges. By tracing the circuits, it will be clearly seen that it is imposible for an operator to listen in while two subscribers are in conversation.

Fig. 2 shows a two-way listening and a two-way ringing key mounted on the same escutcheon plate. From this it will be seen that the keys look about like those usually employed in switchboards. The invention, therefore, is not one of complicated apparatus, but a simple arrangement of circuits. It is interesting, furthermore, to note that the estimated extra manufacturing cost of equipping a new one hundred line board is less than ten dollars.

Regarding the former state of the art, perhaps no other invention approaches the solution of the problem so closely as does the old and abandoned common call wire system, in which the operator connects any two subscribers' lines by a pair of cords having no connection with her telephone. The system became obsolete on account of the dire confusion produced by any number of subscribers trying simultaneously to address the operator who listens continuously on the common call wire. It lacked complete secrecy, as the orders of any calling subscriber could be heard by any one or all of the other subscribers. It has no bearing upon modern telephone traffic, because it is a thing of the past. It is dead, except in places like Glasgow, in the municipal plant, and there is moribund.

As in the art of watchmen's clocks (which until recently have defied the cunning of the night watchman in vain), so in the art of the telephone, former inventors have attempted to devise a system which would be perfect, and that would be independent of the employee's sense of honor. The principal attempts in secret telephony will be briefly mentioned.

A patent, No. 756,424, of April 5, 1904, is upon an invention entitled "Secrecy System for Telephone Switchboards." However, this system is deficient in failing to provide for one important contingency. Practically and theoretically, the secrecy seems to depend upon the operator being so stupid as not to think of listening by merely connecting the two subscribers with plugs of different pairs, connecting the two plugs together by maintaining her telephone set connected with each pair of cords, and thus listening to the conversation between the subscribers. Operators become extremely intimate with their switchboards, and therefore this expedient would soon occur to their minds.

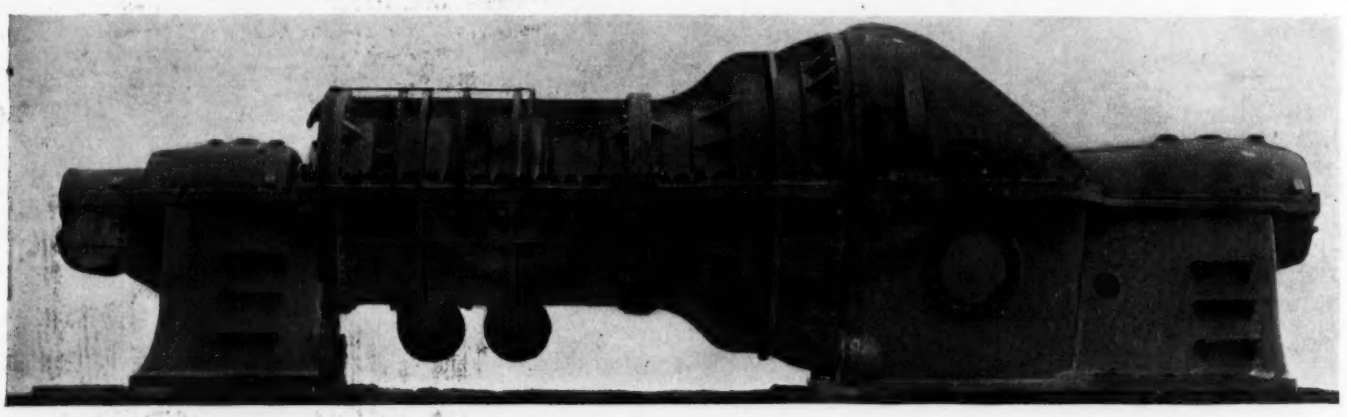
In patent No. 785,673, of March 21, 1905, an invention is described for the alleged purpose of securing secrecy, but it should properly be classed with the abandoned common call wire system as equally useless; for when the signaling generator is brought into circuit to signal on any one subscriber's line, the signaling current will pass to every subscriber's station where the receiver is on the hook. All or none of the subscribers would be signaled, according to whether the generator is powerful enough to ring all the subscriber's signals in parallel. Independently of this prohibitive feature, the jacks and plugs disclosed in the patent could be manipulated for listening in on the "connections" almost as conveniently as by the ordinary bridging key. Thus is chronicled another effort toward the desired end, but which still falls short of attaining it.

Heretofore, others have alleged a solution of the problem of secret telephony, but the evidence, it seems to me, shows, as in the instance cited, that Mr. Beard is the first and sole inventor of a system that is in itself, operative, simple and practical—as secret as a sealed message—and at the same time differing radically from the abandoned common call wire installation and former attempts generally, in being readily applicable to the modern and standard cord or cordless telephone exchange switchboard, and still not involving visionary and undesirable complications, like relays, "attachments," or intricate mechanisms. For these reasons, it was thought by the writer, that an article on the subject might be of interest to the readers of the leading electrical periodical. Recently the invention was installed and given a thorough trial in actual service, in the exchange at Elizabeth, N. J. The result indicated a successful solution of this important problem. On the whole, the invention appears to be the most marked advance in the telephone art in recent years.

Allis-Chalmers Steam Turbine for the Brooklyn Rapid Transit Power House.

The sixth of the huge power plants to be constructed for the Brooklyn Rapid Transit Company will show, in some respects, a radical departure from the features usually found in stations where reciprocating engines are installed. Among the more important of these is the small floor space needed for the machinery. The engine room of the ordinary station requires 60 per cent of the total ground space, and the boiler section 40 per cent. In the new plant the turbine floor occupies but two-thirds the space required for the boilers. The new Williamsburg station, which has been erected near the bridge of that name, is designed to accommodate a total of nine steam-turbine and generator units, three of which are now being installed. One of the most interesting of these is the Allis-Chalmers 9,000-hp unit. A view of the body of the turbine, as it appeared when loaded on a 36-ft. flat car for shipment from the West Allis Works of Allis-Chalmers Company, is shown in the illustration herewith. The turbine is of the horizontal multiple expansion, all-around parallel flow type, generally known as the Parsons type, operating at 750 r.p.m. The generator is a Bullock alternating-current machine built by the Allis-Chalmers Company at its Cincinnati works. It will carry 25 per cent overload continuously and 50 per cent overload for three hours with but small temperature rise.

A noteworthy feature in the construction of the turbine is the



BODY OF 9,000-HP STEAM TURBINE FOR NEW WILLIAMSBURG POWER HOUSE OF THE BROOKLYN RAPID TRANSIT COMPANY.

blading. The blades are made of a special alloy and of such form and dimensions as are calculated to secure the highest economy. The individual blades are mounted in groups, each group forming one-half of a circular row. The inner ends of the blades are swaged, firmly secured in accurately spaced slots in foundation rings and riveted in slots in their respective channel-shaped shrouds. The blade rings are secured by special calking strips in accurately machined grooves in the cylinder and rotor, thus absolutely insuring against throwing out due to centrifugal force.

The channel-shaped shroud secures the blades in a substantial manner at the proper angle and spacing and eliminates the danger of stripping, permitting the turbine to be safely operated with a minimum radial clearance. This special design of blading does away with hand work. The machine construction insures great strength, perfect alignment and uniformity in the spacing of the blades.

The lubricating arrangement is free from complication, complete and efficient. It is equipped with a direct-acting steam pump for use on starting up the turbine. The turbine and generator rotors are direct-connected by a flexible coupling, each being carried in two bearings of the ball and socket type.

In the generator design especial attention has been given to thorough ventilation. The turbo-generating unit measures approximately 47 ft. in length, over all, 13 ft. 3 in. in width and 11 ft. 6 in. in height above the engine room floor. Its height above the foundation is scarcely more than that of the low-pressure cylinder of a reciprocating engine of equal capacity, above the upper platform, and such cylinders are frequently more than 30 ft. above the engine foundations.

Electrical Equipment of a Paper Box and Bag Factory.

BY F. F. COLEMAN.

One of the handsomest and most interesting industrial power plants ever erected in Greater New York is the new installation which has just been completed by the Allis-Chalmers Co., of Milwaukee, for the Robert Gair Company, of Brooklyn.

The power equipment was entirely furnished by the Allis-Chalmers Co. The three main units consist of its well-known Reynolds-Corliss heavy-duty type engines, direct-connected to Bullock engine-type generators. A smaller sized engine and a Bullock direct-connected generator together with a Bullock switchboard admirably adapted by its design for the distribution of the power, complete the power equipment of the plant.

From the day when Mr. Gair opened his first factory and salesroom at 163 Chambers St., New York City, in 1864, the engines and power equipment of each plant were chosen to represent the very best of their time. They were always placed with discrimination at points from which power could be distributed throughout the plants evenly and without strain, thereby ensuring the duration and good condition of the driving machinery. This branch of Mr. Gair's factory departments was a matter of personal interest and a source of pride with him.

Mr. Gair's first power equipment of forty years ago consisted of a hot-air engine of 7 hp. A comparison of this with the Allis-Chalmers Co.'s extensive, modern power plant just installed tells eloquently the story of the Robert Gair Co.'s strides. This engine was soon replaced by a Baxter engine of 15 hp, and a year or two later a Buckeye engine of 30 hp was installed. As the expanding

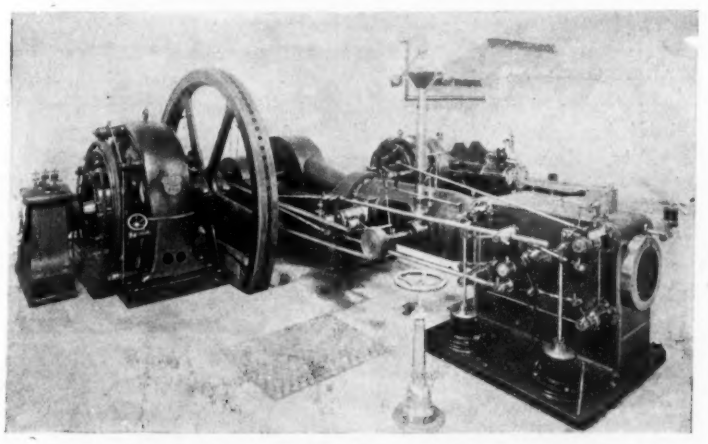


FIG. I.—VIEW OF ONE OF THE UNITS.

business required the occupancy of one building after another until it filled four four-story structures, two on Chambers St. and two on Reade St., a second Buckeye engine of the same capacity was added.

The basis of the Robert Gair Company's business was the manufacture of folding paper boxes and paper bags. The development of what are now commercial necessities in extensive demand began with the manufacture of a simple folding box for carrying notions and a grocer's bag, and from the production of these Mr. Gair's business expanded in all directions to meet the conditions and opportunities which he discerned. Crude wrappers were replaced by handsomely designed cartons and the modern inclination to pack and market goods attractively was allowed scope. Individuality was given to packages and advertisers, led by both instinct and necessity, employed the goods so widely that the manufacture of folding cartons has become a vast industry, entailing not only the use of intricate machinery but also the employment of artists, designers, etchers and printers. The Robert Gair Company at present not only manufactures paper cartons and bags, but also envelopes, corrugated paper, lace papers, solid paper boxes, embossed show cards and paper specialties. In addition it has an extensive label printing plant, equipped with the very best facilities for electrotyping, engraving and ink making. In almost every line produced by this firm Mr. Gair was the pioneer, and the double task of educating the public to the uses and advantages of its manufactures and of constructing the special machinery required were undertaken with widely recognized success.

When the four buildings in Manhattan were no longer adequate the business was transferred to Brooklyn and in 1891, the first of the three factories, of which the plant now consists, was erected under the shadow of the Brooklyn Bridge, covering the block on Washington Street, between Plymouth and Water Streets. This factory is 100x200 ft., and six stories tall. The power plant for Factory No. 1 consisted of a Watts-Campbell Corliss engine, with a 16x18-in. cylinder, developing 125 hp at 70 r.p.m. Electric lights were introduced into this factory and the lighting plant consisted of an 8x10-in. Payne engine belted to an Edison 110-volt, 600-light generator.

Soon more room was required and a large plant, known as Factory No. 3, at John and Gold Streets, and another, known as Factory No. 2, opposite Factory No. 1 in Washington Street, were added. Each factory was provided with its own separate plant. The power plant at Factory No. 3, where solid boxes, lace papers and corrugated paper are manufactured, consisted of a Wright-Corliss, 80-hp engine, and the lighting was cared for by a Mather generator, belt-driven, which furnished current for 300 110-volt lamps. The equipment at Factory No. 2, which was the label printing plant, was composed of two Weston high-speed engines. Electric drive for some of the machinery was first introduced into this factory and current at 110 volts for operating them was furnished by two Westinghouse and two Siemens & Halske generators—each of 75 kw capacity.

The necessity for more room became apparent last year, and the work of erecting a new factory covering the block on Water Street, between Washington and Adams Streets, was begun. At the same time plans were made for doing away with the three separate power and lighting plants by erecting and equipping a new central power plant and other improvements.

The new factory, the power house and a new stable on Main Street are all constructed of reinforced cement. The new factory is a conspicuous object from the Brooklyn Bridge, and the novel method and material of construction have attracted much attention from there as the work progressed. The new factory is nine stories in height and measures 100x230 ft. in area. Each of the three concrete buildings forms a solid monolith. The value of this form of construction is particularly apparent in the power house where walls, floors and engine foundations are all intimately joined together.

The new power house stands in the rear of Factory No. 1, and faces on Water Street. It is 44 ft. wide, 130 ft. long and one story high. The front wall is of brick to match the older building beside it. All the rest is of cement concrete. The engine-room opens on the street and runs back 70 ft. Wide doors give ease of access, and windows and skylights furnish light and ventilation in ample degree.

The switchboard occupies a place near the front of the room, to the right hand as one enters and side by side down the length of the room, each with its longitudinal line running across the room are the direct connected Allis-Chalmers engines and Bullock generators which replace the entire three older plants and furnish power and light to the entire works. At the rear of the room opposite the switchboard is a 100,000-gal. fire pump.

The first feature of the room which attracts the attention of the observer is the absence of piping. Except where some short pipes reach through the rear wall to the steam pump and to the 50-kw unit, there is not the vestige of a steam pipe in the room. Both the live steam and exhaust pipes are carried under the floor. Neither is there a wire conduit nor a wire in sight except at the back of the switchboard. All the connecting wires are carried in conduits built into the solid concrete flooring and walls.

There are four steam-electric units so sized and arranged as to provide any amount of current needed from 50 kw, by steps of 50 kw. First in order as they are set as well as in importance come two 200-kw units. Next is one 100-kw unit and last a 50-kw unit.

Each of the 200-kw units and the 100-kw unit consists of a Reynolds-Corliss engine of the heavy duty type with a direct-connected Bullock engine-type generator. The larger engines have cylinders 22 in. in diameter with a 36-in. stroke. Steam is furnished at a pressure of 100 lb. to the inch at the throttle and the engines run at 100 r.p.m. The throttle valves of all the engines are under the floor with the stands and handwheels rising beside the engines near the cylinders on the valve gear side.

The 200-kw engines have balance wheels 14 ft. in diameter. The

wheels are made in halves. They have square rims with barring-holes cast in the rims. The wheels weigh 20,000 lbs. each.

The valve gear is of the double eccentric style with a long range cut off. The valves are double ported. Richardson feed oil pumps supply lubrication to the cylinders.

The engine of the 100-kw unit is of the same type as the larger ones and differs from them only in size. Its cylinder is 16 in. in diameter and 36-in. stroke. It operates at 100 r.p.m. It has a balance wheel 12 ft. in diameter weighing 12,000 lbs. The main journals measure 8 in. in diameter and 15 in. in length, and the crosshead pin is 4 in. long and 4 in. in diameter. All three of the engines have counterbalanced disc cranks.

The 50-kw unit, which was also furnished by the Allis-Chalmers Company, has a Harrisburg-Fleming side crank, self-oiling engine of 80 hp, running at 275 r.p.m. It cuts off at ¼ stroke. Owing to

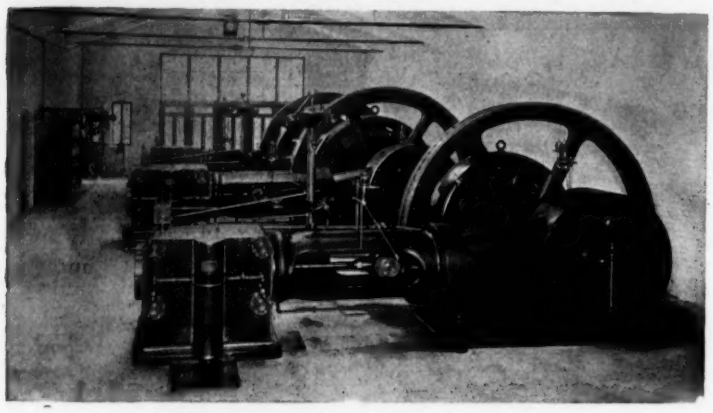


FIG. 2.—GENERAL VIEW OF ENGINE ROOM.

a difficulty in providing condensing water as well as a desire to use the exhaust for heating purposes the entire plant is non-condensing.

The engines are guaranteed when running on a full and even load with 100 lbs. steam pressure and no back pressure, not to consume more than 25 pounds of dry steam per i.h.p.-hour. They are also guaranteed not to vary in speed more than 2 per cent above or below the normal under all changes of load within their capacity.

The four Bullock generators are all of the direct-current engine type and have the following characteristics:

Number of Units	Type.	Normal Speed R.P.M.	Normal Rated Capacity in K-W.	Normal range E.M.F. in volts. from	to	Normal Current Capacity in Amperes
2	Engine	100	200	115	120	1,666
1	"	100	100	115	120	833
1	"	275	50	115	120	416.6

Each is guaranteed to be capable of carrying its full normal load continuously for 24 hours without sparking and without heating the windings more than 40° C. or the commutator more than 45° C. above the temperature of the surrounding atmosphere. They are capable of taking a 25 per cent overload for two hours following a full day's run at full load without heating more than 100° C. above the figures for the day's run, and if required will carry a momentary overload of 75 per cent without flashing. They will go from no load to 25 per cent overload without shifting the brushes.

The switchboard is so designed that current from any one of the generators, all of them, or any combination of them, may be distributed to the three factories at will, either for lighting or for power. It contains ten panels.

The panels are built of black enameled slate, each finished with beveled front edges and mounted on a rigid angle iron frame. The panels are 70 in. in height with a base panel 20 in. wide. Beside its regular instruments each panel is provided with a lamp and shade mounted on a bracket. Each has its bus-bars and connections complete. One panel, corresponding to the others, is left vacant for future use.

The first panel carries at 150-volt Weston voltmeter on a swinging bracket. There are four generator panels, one for the 50-kw unit, one for the 100-kw unit, and one each for the two 200-kw units. Each carries a laminated type circuit-breaker, a Weston ammeter, a three-point, single-throw knife switch, and a voltmeter switch, all of proper capacity, and each has its rheostat mounted on the back of the board.

The feeder panels for Factories Nos. 2 and 3, are each 16 in. wide and contain one 2,500-ampere, 110-volt, two-wire integrating wattmeter and two 1,000-ampere knife switches with fuses on the rear of the board. The feeder panel for Factory No. 1 is of like width, and its instruments are similar, except that the wattmeter is of 1,250-ampere capacity and the switches of 1,000-ampere capacity each. There are two distributing panels each 24 in. wide. Distribution panel No. 1 contains a 600-ampere Weston ammeter with 8 shunts and an 8-point ammeter switch, and 8 400-ampere, double-pole, single-throw, knife switches.

Distribution panel No. 2 contains a 300-ampere Weston ammeter with 8 shunts, an 8-point ammeter switch and 10 200-ampere, double-pole, single-throw knife switches.

The foundations for all the engines form one solid mass of concrete 70 ft. long, 12 ft. wide and 14 ft. thick with wings 12 ft. long and 6 ft. wide added for each heavy duty engine to support the cylinder end. The wings reach straight down to the earth level excepting the one under the 16x36-in. engine which has its foot cut away at a slant to allow room for turning a boiler in case it becomes necessary to take any of them in or out for repairs or replacement. Along the continuous 70-ft. side the foundation mass has added to it the 30-in. outer wall of the building, while over it all and forming one with it is the 5-in. thick concrete floor reaching to a 36-in. wall, on the opposite side.

Except for the subdued sound of the valve gear the engines run noiselessly and so smoothly that not the slightest tremor can be discovered, when a coin is balanced edgewise on the cylinder with its face line transverse to the line of action of the piston rod.

The boiler room is in the rear of the engine room and is 44 ft. wide and 60 ft. long. It rises in the clear 30 ft. from the basement level to the roof and is plentifully supplied with light and air from skylights, and from vault lights at the front of the open passage beside the engine foundations. It contains six Basshor & Sons' horizontal tubular boilers, each 6x18 ft. and containing 104 3½-in. tubes. The smoke flues connect to a header flue which leads directly to a steel stack 5 ft. in diameter and 140 ft. tall. The steam from all the boilers is received by a straight header 12 in. in diameter which runs directly under the three larger engines and is connected to each by suitable piping. The two 22 by 36-in. engines have 8-in. connections and the 16 by 26-in. has a 5-in. pipe. The

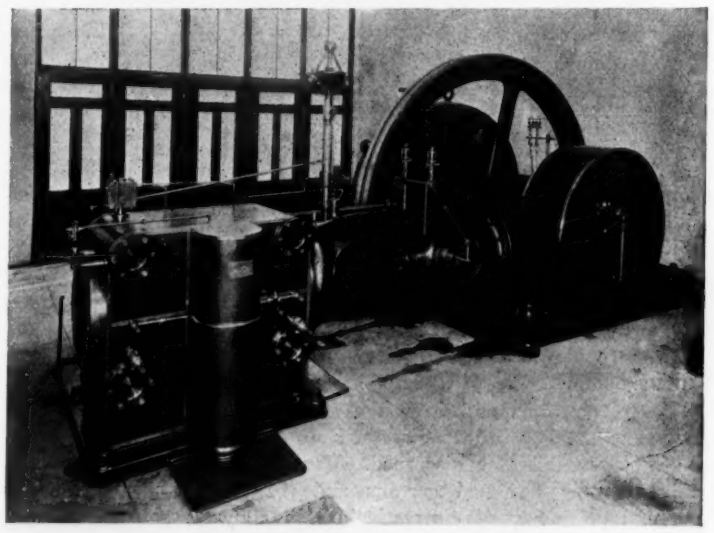


FIG. 3.—SIDE VIEW OF ONE OF THE UNITS.

boilers are so arranged that any one of them can be cut out, whether one or all of the engines are running. In addition to this, two of the boilers which back up against the engine room wall are arranged so as to be connected independently with either the fire pump or the Harrisburg engine. This arrangement permits of the independent operation of the 50-kw. unit. This is important for this unit ordinarily furnishes the lighting current and is used also to operate the elevators and any small part of the works where it might be necessary to carry on work at night or other times when the general plant is shut down.

The exhaust steam pipe returns in a line parallel to that of the

live steam pipe. It brings the exhaust steam to a "Utility" feed-water heater and purifier. Here the oil is trapped and sent into the sewer and feed water is heated.

The exhaust steam escapes from the heater into a 12-in. header, from which it is sent out to Factories Nos. 1, 2 and 3 through 6-in. pipes. When it is not needed for heating purposes in the buildings it is allowed to escape into the atmosphere through pipes which lead to the roof of each building. When heat is needed the steam is drawn through the system of heating pipes by a pump in the boiler room which brings all the steam back into the heater, but this time it passes into the feed water section.

Oil for lubrication is circulated through a system of pipes by gravity from a tank situated about 15 ft. above the engines. After passing through the engines it goes to a filter and is there pumped back to the tank.

With the installation of the machinery in the new concrete factory No. 3, the Robert Gair Company will complete the equipment of its works with electric drive. Besides 2,000 16-cp incandescent lights to be maintained, the variety of the operation carried on by electric power in the plant is almost infinite.

This work includes printing, lithographing, embossing, punching and all the complex operations which are necessary in producing a variety of paper goods which ranges from the rough corrugated paper used for packing purposes to the filmy lace papers used to grace delicate confections, or to decorate the table.

There is hardly a household in the land where the products of the Robert Gair Co. are not known. Uneeda biscuit boxes, Pearline and Fels Naphtha packages are among these and compartment cigar cases, candy boxes, labels, enameled show cards and envelopes for seeds, gloves and other goods are turned out by the millions.

"If it's made of paper, we have it" was the motto of the firm for years, but recently it has been compelled to restrict its product to a few score of specialties. Between 1,100 and 1,200 machines of various kinds are employed in the making of the goods. Many of these were invented and built in the works. Something like 60 motors or more, big and little, will be employed to keep all of these machines in motion when the electrical equipment is complete. The motors will range in size from 5 hp to 30 hp each.

Telephone Transposition Insulator for High-Potential Power Lines.

When telephone wires are placed upon the same poles with high-potential power lines, it is desirable that a high degree of insulation be used with the telephone wires in order to minimize the liability of current jumping from the pole or tower on to the telephone wires and thereby working destruction sometimes of both life and property. The accompanying illustration shows the No. 8A transposition insulator of the Locke Insulator Manufacturing Company, Victor, N. Y., which has been designed for the support of telephone wires on the same poles which carry the high-voltage wires. A prominent feature of the insulator is the great arcing distance between the telephone wires and the support. It will be noted further that there has been provided between the two telephone wires a small petticoat which affords ample insulation between them. This insulator is made in one piece, and is characterized by great mechanical and electrical strength.

TELEPHONE TRANSPOSITION INSULATOR.

Monarch Aluminum Reflectors.

The illustration herewith shows a device which, when placed on an incandescent lamp, serves to increase the light in a downward direction, and at the same time allows sufficient light to pass upward in order to avoid dark spots on the ceiling. The reflector is made of aluminum, and, although being of small weight, it is very durable. This device, which is called the "two-light" reflector, is manufactured by the Sarco Company, 906 Sixth Ave., New York, for the American Electrical Novelty & Manufacturing Company.

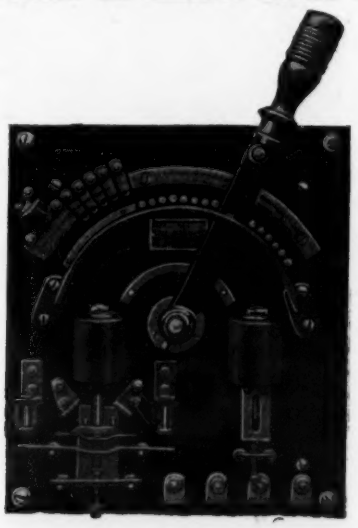
"TWO-LIGHT" REFLECTOR.

Printing Press Controller.

The accompanying illustration shows a 3-hp, 125-volt Ward Leonard printing press controller designed to occupy but little mounting space and equipped with apparatus for obtaining speed regulation by both armature and field control. The armature circuit is made and broken by a quick-acting solenoid switch, so that no arcing can take place due to improper manipulation of the controlling lever.

The design is such that should an overload occur the solenoid switch quickly breaks the circuit and the circuit cannot be made again until the speed-controlling lever is moved to the proper starting position. The no-voltage release device is responsive solely to the line voltage and is entirely independent of the field current or of the armature current.

The controller is protected against overload at all times. The overload circuit-breaker has laminated contacts to carry the current, and it has six independent points at which the circuit is opened, each of the two laminated contacts being protected by two auxiliary contacts. The final breaking points are equipped with magnetic blow-outs. The lever must be held squarely on the controlling contacts. There is no strain upon the controlling arm. The movable contacts are of the skate-shoe type, able to ride over any obstruction standing 1/16 in. above the contact surface.



PRINTING PRESS CONTROLLER.

Self-Contained Electrical Fountain.

The electro-luminous fountain shown in Figs. 1 and 2 is an exceptionally attractive decorative device, which has recently been placed upon the market in this country. The device consists of a small electric motor and a pump, the latter being placed in the interior of a basin and connected directly to the motor shaft. The pump draws water from the bottom of the basin, and conveys it to a length of pipe, circular in form, in which are placed numerous nozzles through which water passes to produce cascades. In the center is placed an incandescent lamp, the light from which passes through a varicolored shade which is revolved by the impact of the water from an internal nozzle, and which serves to protect the lamp from the water of the cascades. The water from the cascades falls on the revolving shade and returns to the basin, and is again drawn into the pump. When the basin is once filled it is unnecessary to renew the water for a considerable length of time. It is worthy of note that the piping of the device is self-contained, and that no external water piping is needed. The only external connection is made through a substantial lamp cord from any convenient lamp socket.

FIG. 1.—ELECTRO-LUMINOUS FOUNTAIN.

These fountains furnish excellent decorations for private houses, and they serve to keep the air cool and moist. In addition to those for private houses, special designs have been built for lobbies and parlors of hotels, theatres, florist stores and as decorations for dinner parties and for show windows. They can be moved from one place to another without trouble, since there are no water pipe connections, and the electrical circuits can be substituted for or connected to those of any incandescent lamp. A United States patent for this device has been issued to Max Levy, of Berlin, Germany. It is stated that since they were placed on the market in Germany many have been sold, and the demand for them is increasing rapidly. Several of them have already been introduced in this country. The sole agent for this fountain for the United States and Canada is the Electrical Accessaries Company, 1135 Broadway, New York.

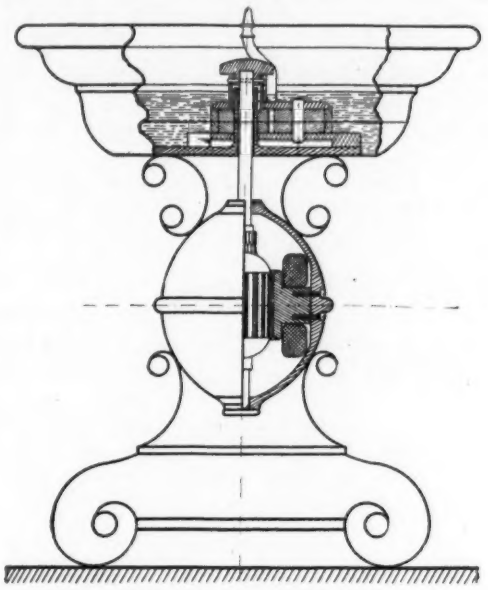
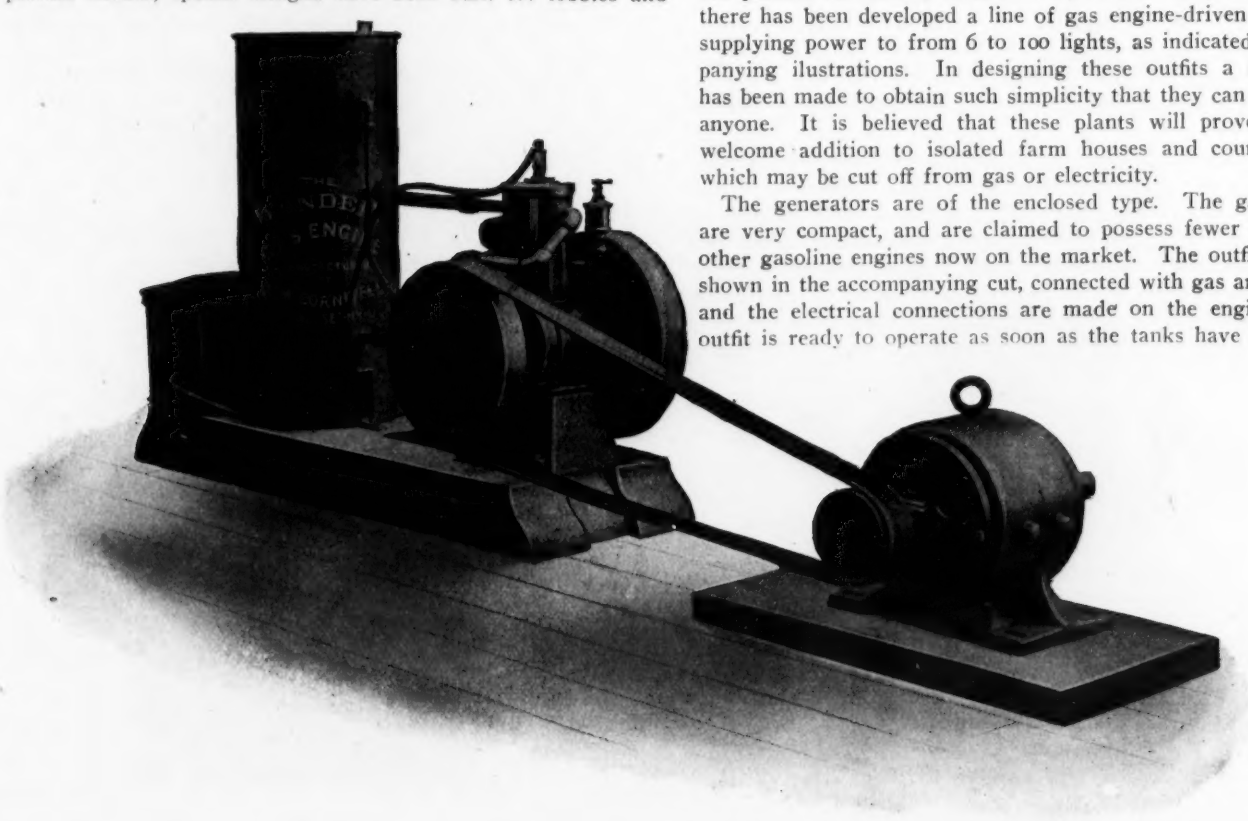


FIG. 2.—PART SECTIONAL VIEW OF ELECTRICAL FOUNTAIN.

"Wonder" Electric Lighting Outfits.

In order to meet the demand for complete electric lighting outfits for private residences, farm houses, house boats, shops and stores, there has been developed a line of gas engine-driven generators for supplying power to from 6 to 100 lights, as indicated in the accompanying ilustrations. In designing these outfits a special attempt has been made to obtain such simplicity that they can be operated by anyone. It is believed that these plants will prove an especially welcome addition to isolated farm houses and country residences which may be cut off from gas or electricity.

The generators are of the enclosed type. The gasoline engines are very compact, and are claimed to possess fewer parts than any other gasoline engines now on the market. The outfit is shipped as shown in the accompanying cut, connected with gas and water tanks, and the electrical connections are made on the engine so that the outfit is ready to operate as soon as the tanks have been filled. It is stated that the cost of operating the engine is about one cent per hp-hour, or about one-tenth of a cent per hour for each 16-cp lamp.



"WONDER" GASOLINE ENGINE BELTED TO ENCLOSED GENERATOR.

These equipments are manufactured by the R. M. Cornwell Company, Syracuse, N. Y., and are designed to conform to the requirements of the Board of Underwriters.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade has been stimulated by the colder weather and seasonable merchandise is moving freely. Leading branches of manufactures are making good progress, most mills and factories having orders for more remote delivery than is customary, and especially favorable statements are made respecting lumber and flour mills. It is no longer cause for comment when new records of output are established, as this has become the rule rather than the exception. Iron and steel in all forms are active as never before at this late stage of the year. A large sale of iron, 40,000 tons, has been made to the leading interest, which cleans up about all the Bessemer iron available for the remainder of the year. Other points note similar scarcity of other grades. Finished products are actively in demand, and the mills are pushed for deliveries, although close to full capacities are employed. Bessemer iron is quoted at $17, valley furnace, with $18 predicted before January 1. At Chicago, foundry iron is 50 cents up, and $3 higher than the low point of the year. Large sales for the first half of 1906 are reported. The car shortage still affects coke and coal shipments, and the movement of these commodities this winter is a serious problem. Although the congestion in railway matters has been relieved at some points, notably at lake and rail centers, complaints as to car shortages affecting the movement of grain and collections come from the northwest; coke and coal movements are menaced in the central west, and the lumber movement in the Pacific northwest is hampered. Collections generally are freer, and there are signs of the return movement of currency from the country balancing the outgo. Labor is occupied as rarely if ever before at this season; fear of cotton-mill strikes has faded, and reports from factories in widely separated sections are that they are running to their fullest capacities. Dullness characterized the copper market, and a few sales were made at slightly lower quotations. Lake and electrolytic are quoted at 16.50c and casting stock 16.25c. In their circular, D. Houston & Co. say this of the copper situation: The phenomenal domestic consumption of copper is fully attested by the intensely active conditions prevailing at the brass and copper mills of the country. Manufacturers have orders in hand which for months ahead will tax the utmost capacity of their plants, and the first three to six months of 1906 are expected to be an exceedingly busy period. The outlook for great activity in copper next year is most promising, and if values are kept at a reasonable level a very urgent demand practically seems assured. Consumption has developed to immense proportions, and it may be expected to increase with production. If there is a plentiful supply of copper to feed the new demands arising for its use, consumption will have a better chance to expand and demand will increase in importance as a factor of unprecedented force. It is thoroughly demonstrated that there is enough copper for electrical uses and the new modern utilities thus far, and therefore the development of these recent improvements can be promoted rapidly. Failures for October, says *Bradstreet's*, are at the minimum for that month, numbering 804, a decrease of 4.4 per cent from a year ago, and an aggregate practically as low as the lowest reported in October for 13 years past. One-third of the total liabilities of $12,600,683 for the month of October is accounted for by three bank failures. The number of failures reported for the week ending November 2 is 160, against 178 the week previous and 200 the corresponding week last year.

ELECTRIC RAILWAY EQUIPMENT.—The Ocean Shore Railway Company, which is constructing a double-track electric road from San Francisco to Santa Cruz, has closed contracts for its electric equipment and power house plant. The power house will be erected at Balboa on Half-Moon Bay, by Charles C. Moore & Co., of San Francisco, who have the contract to supply and erect everything except the electric equipment. The General Electric Company will supply all of the electrical plant. Two 2,000-kw, 2,300-volt, 25-cycle flywheel-type generators will be direct connected to two McIntosh & Seymour vertical cross-compound engines making 107 r.p.m. Of the two 125-kw exciters one will be driven by a Harrisburg engine and the other by an electric motor. Seven 1,000-kw oil-cooled transformers will raise the voltage from 2,300 to 30,000 volts. Thirty 250-kw lowering transformers will reduce the current to 440 volts at the sub-stations, where ten 6-phase rotary converters will furnish direct current at 500 volts to the trolley wires. Eight sub-stations will be located at intervals of about ten miles, and two will be mounted on cars so as to be portable. Forty 4-motor car equipments, each motor of 125 horse-power, have been ordered arranged for multiple control, although as a rule single cars will be operated except when there is a rush of traffic. The overhead work will be of catenary construction insulated for 6,000 volts, so that whenever it becomes advisable the line can easily be changed over to an alternating-motor system. The boiler plant will include five 600-hp Babcock & Wilcox wrought-steel boilers, carrying 200 pounds pressure and equipped with superheaters. Wheeler condensing apparatus will be installed, and all auxiliaries will be steam driven. A salt water pumping system will supply circulating water from the bay. Crank and flywheel air pumps of the Edwards type will be used and centrifugal circulating pumps. Improved oil-burning apparatus will supply the furnaces. There will be a Weber concrete steel stack, eight feet in diameter and 125 feet high.

JERSEY MEADOW IMPROVEMENTS.—The New Jersey Terminal Dock and Improvement Company, recently incorporated at Trenton, has bought the meadow tract known as the "Pike estate," extending from Harrison to the west bank of the Hackensack River, opposite Jersey City. The company is capitalized at $3,000,000, and is also authorized to issue $3,000,000 in bonds. Of this amount $1,800,000 has already been issued. Walter G. Oakman, of New York, is president, and Pliny Fisk, the banker, is vice-president. The other directors are Andrew Friedman, William M. Barnum, W. L. Lane, Charles D. Barney, George R. Sheldon and W. C. Kinney. With two exceptions, all these are directors in the Hudson Street Railroad Company, whose object is to build trolley roads from all the towns in Hudson County to connect with the tunnels under the Hudson River to Morton and Cortlandt Streets. The New Jersey Terminal Dock & Improvement Company, the Hudson Street Railroad Company, and the Hudson Companies, which are building the tunnels, are practically one enterprise. The meadow tract, comprising about 4,000 acres, has been acquired for general purposes, such as a central power house and car sheds.

GESELLSCHAFT FÜR DRAHTLOSE TELEGRAPHIE, Berlin, reports increased activity in the installation of apparatus for wireless telegraphy. The enormous station of 1,500 km range, ordered by the German Post Office, will not, as first intended, be erected at Borkum, but at Norddeich, near Norden (North Sea). The laying of the foundations has so far progressed, that the building of the towers 65 m high can soon be taken in hand. The "Kaiserliche Marine" has ordered two coast stations on the Baltic Sea. Two complete overland stations have been ordered for Rost and Soervagen, Norway. The construction of stations for the fortresses Almeria and Melilla, in Spain, will soon be begun. The Dutch Navy has ordered three stations of 500 km range. A cruiser looking after the interest of the Danish fishing trade in the seas of Iceland will soon be equipped with wireless apparatus. Instructions have been received from the authorities of the pilot and life boat service of Finland to equip the lighthouse Marieham and Bogoker with telefunken stations. The Argentine Navy has Telefunken apparatus in use on four warships, namely, Julio, Patria, Libertad and Independencia.

THE S. MORGAN SMITH COMPANY, of York, Pa., has recently completed the installation of six turbine water wheels for the Berkshire Power Company, at Canaan, Conn. Each turbine is to develop 120 horse-power under 11 ft. head. These turbines are installed in sets of three, each three turbines being geared to a jack shaft which is coupled directly to an electrical generator. The current generated is to be used for lighting and power purposes. The company has also furnished recently two horizontal water wheels to the Lombard Governor Company, at Ashland, Mass. These wheels are to be used for supplying power to its factory, and also to be used in connection with testing water wheel governors, the manufacture of which is the principal business of this company.

NATIONAL LEAD COMPANY.—The Atlantic works of the National Lead Company, of Brooklyn, N. Y., the largest factory for the production of white lead in the United States, is being reconstructed so as to distribute all power electrically. Plans have been completed for displacing 14 steam engines of various sizes and over 40 steam pumps located throughout the works by one 600-hp, tandem, compound, condensing engine direct-connected to an electric generator supplying two-phase induction motors. The contracts have already been let for part of the apparatus, and it is expected the rejuvenated plant will be put in operation in January. Henry Floy, of the St. Paul Building, New York, consulting engineer, for the National Lead Company, has the matter in charge.

ALLIS-CHALMERS.—It is stated from Chicago that President Whiteside has denied the rumor that the Allis-Chalmers Chicago shops are to be moved to Milwaukee.

RECENT WESTINGHOUSE-PARSONS TURBINE ORDERS.—The Westinghouse Machine Company, of East Pittsburg, Pa., has within the last few weeks received numerous orders for its turbines, among them being one from the Lumberton Cotton Mills, Lumberton, N. C., for one 300 kw turbine; from the Waltham Gas Light Company, Waltham, Mass., for four 500 kw turbines; from the Gulfport & Mississippi Coast Traction Company, Gulfport, Miss., for two 500 kw turbines; from the Suburban Electric Company, Scranton, Pa., for one 500 kw turbine; from the Pennsylvania Light & Power Company, Pittsburg, Pa., for one 500 kw turbine; from the Water, Light & Gas Company, Hutchinson, Kan., for one 500 kw turbine, and from the Winston-Salem Power Company, Winston-Salem, N. C., for one 750 kw turbine. The turbine ordered by the Lumberton Cotton Mills will be of the well-known multiple expansion parallel-flow type driving a 60-cycle direct-connected generator running at 3,600 r.p.m. It will operate at 150 lbs. steam pressure and 26-in. vacuum and deliver three-phase current at 440 volts. The turbines for the Waltham Gas Light Company will be of the same type and frequency, operating at 3,600 r.p.m. with dry saturated steam at 175 pounds gauge pressure and 28-in. vaccum. The alternating current generators will be of the rotating field turbo type delivering three-phase current at 2,300 volts. The Suburban Electric Company's turbine with characteristics similar to the above will operate with dry saturated steam at the throttle of 150 lbs. gauge pressure and with atmospheric pressure in exhaust pipe, and will be capable of developing 750 hp. The turbines for the Gulfport & Mississippi Coast Traction Company will operate under 150 pounds pressure, 28-in. vacuum and 100 deg. Fahr. superheat, and will be direct connected to 60-cycle turbo generators running at 3,600 r.p.m.

NEW ENGLAND POWER PLANTS.—The S. Morgan Smith Company, of York, Pa., is installing for the American Optical Company at Southbridge, Mass., two pair of horizontal turbines, with an aggregate of 500 hp under 11 ft. head. Each pair of these wheels is connected to a belt-driven generator, and the current is to be used for operating the machinery of the latter company. The speed of each pair of turbines is regulated by a Lombard governor, and the arrangement will be such that, although each pair of wheels is in a separate power house and the engine room at a third location, either pair of turbines can be stopped or started and the speed controlled from the switchboard which is located in the engine room. The S. Morgan Smith Company is also furnishing the International Paper Company for its power plant at Livermore Falls, Me., a hydraulic equipment, consisting of six pair of turbines, each pair to develop over 1,300 hp under 32 ft. head; also one small wheel to drive an exciter unit. These wheels are all mounted on horizontal shafts and set in steel cases and are direct-connected to pulp grinders and electrical generators. The S. Morgan Smith Company is also installing for the Otis Fibre Board Company at Russell, Mass., two pair of horizontal wheels, each pair to develop 400 hp under 22 ft. head. These wheels are to be direct-connected to electrical generators, the current from which will be used for industrial purposes. This installation is unusual, from the fact that the wheels and generators are all inside of the dam, the wheels setting in concrete flumes, and the walls of the generator room being of water-tight concrete construction. The wheel pits and tailraces are formed by arches underneath the dam.

INCREASING EXPORT TRADE.—The American Consul at Prague, Urbain J. Ledoux, has, on the pattern of a chamber of commerce, established a special bureau called the commercial intelligence department of the Prague consulate, affording every opportunity for the registration and examination of catalogues of all kinds, and so classified that importers and exporters can be posted immediately upon the possibility of their doing business. The catalogues, prices current, discount sheets, etc., must naturally be so arranged so that anybody seeking information can find it at once. Catalogues without prices or discount lists would be useless; moreover, the weights and measures should be reduced to the standards adopted in the country of their destination. Lists of references should also be added. The catalogues and other printed matter are classified according to the different branches, so that the visitor may easily find what he wants. In order that the filing can be done effectually, it is necessary that parties sending printed matter should, at the same time, advise our consuls regarding the various specialties they handle, so as to save tedious searching and to facilitate registration.

TURBINES IN WASHINGTON TERMINAL STATION.—When the large Union station at the Washington terminal of the Pennsylvania Railroad is completed, it will be one of the finest and best-equipped railroad stations in the world, serving all incoming and outgoing trains at the National Capital. In conformity with the rest of the station the power plant will be equipped with the most up-to-date and best machinery obtainable, steam turbines being selected as prime movers partially on account of the limited amount of space devoted to that purpose. Four 500 kw steam turbines have been ordered from the Westinghouse Machine Company, of East Pittsburg, Pa., adapted for driving alternating current 60-cycle generators running at 3,600 r.p.m. Dry saturated steam will be used at 150 pounds pressure and 25-inch vacuum, and the turbines will be capable of developing 670 e.h.p. each. The alternating current generators will be of the turbo rotating field type with two poles and a frequency of 60 cycles at a normal speed of 3,600 r.p.m. They will deliver three-phase current at 2,300 volts, and, being of the enclosed type, will operate practically without noise.

DRAINAGE CANAL CONTRACTS.—The engineering committee of the Drainage Board, on Oct. 30, recommended the award of contracts aggregating $200,000 for the work necessary to transmit the power to be generated by the sanitary district canal at Lockport and Joliet to Chicago, as follows: Switchboards and transformers, the Stanley Electrical & Manufacturing Company, $3,546; oil circuit breakers and switches, the Arthur Frantzen Company, $13,836; rheostats for generators, the Stanley Electric Company, $1,515; bus bar compartments, the Arthur Frantzen Company, $8,629; conduits and wiring connections, the Brennan Electric Construction Company, $6,285.87; transformers and lightning arresters, the General Electric Company, $74,888; aluminum conductors, the Western Electric Company, $423 a mile; erecting aluminum conductors, the Brennan Electric Construction Company, $1,350; high-tension insulators, the Porter & Berg Company, $5,920; electric crane, the Whiting Foundry & Equipment Company, $5,800.

TECHNICAL PUBLICITY ASSOCIATION.—At a meeting and banquet of the Technical Publicity Association, held at the Aldine Club, New York, Friday evening, Nov. 3, the following officers were elected: President, C. B. Morse, Ingersoll-Rand Drill Company; first vice-president, H. M. Cleaver, Niles-Bement-Pond Company; second vice-president, Frank H. Gale, General Electric Company; secretary, Rodman Gilder, Crocker-Wheeler Company; treasurer, H. M. Davis, Sprague Electric Company. Members of Executive Committee—Graham Smith, Westinghouse Companies, and Chas. M. Manfred, Johns-Manville Company. Mr. H. M. Davis addressed the association on "The Advertising Appropriation." An informal discussion followed, in which the members exchanged views on the disposition of advertising appropriations, the relative amount that should be spent in magazine and circular advertising, the relation between the advertising appropriation and the volume of business, etc.

PRODUCTION OF LEAD AND ZINC.—The report of the Geological Survey on the lead and zinc industries of the United States for the year 1905 shows that the production of lead was 307,000 short tons, valued at $26,402,000. The increase in production was marked in Southern Missouri, Southeastern Kansas, Colorado, Utah and Idaho. The lead contents of the output of the Cœur d'Alene district of Idaho is given as 108,854 short tons. The production of spelter in the United States in 1904 amounted to 186,702 short tons, valued at $18,670,200, as compared with a production of 159,219 tons in 1903. The principal increase in the production of zinc has taken place in Kansas, where new plants were started.

WELDED WIRE FENCE.—According to the *Iron Age*, a new development in electric welding is the automatic production of continuous rolls of wire fencing. A number of galvanized wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these are cut off lengths of wire which are fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect they are welded together by means of small transformers. The welded section then moves forward a predetermined distance and the operation is repeated.

HYDRO-ELECTRIC PLANT AT LOWELL, KAN.—The Arnold Company, Marquette Building, Chicago, has issued as Bulletin No. 13 a well-prepared description of the hydro-electric plant of the Spring River Power Company at Lowell, Kas. This plant supplies power to Galena, Joplin and Webb City over a thirty-mile transmission line, the circuit e.m.f. being 33,000 volts. The bulletin deals with all features of the equipment, numerous views being given of the power plant, transmission lines, substations, secondary distributing circuits and motor installations.

PLANT AT WASHINGTON, N. J.—A sale of the Washington Electric Light Company has just been effected by the Gas & Electric Development Company, of Philadelphia, which will also have charge of the extensive improvements to be made immediately and the future operation of the plant. The Washington company has always been a paying enterprise, but under the new management it is expected the earnings will be largely increased.

THE STROMBERG-CARLSON TEL. MFG. CO., Rochester, N. Y., reports having closed contracts for switchboards for the following places: Varna, Ill.; Varich, Mo.; Bouton, Ia.; Atalissa, Ia.; Leonard, Mich.; Stuttgart, Kan.; Stromsburg, Neb.; Stelhensport, Ky., and Yates City, Ill.

ELECTRIC ELEVATOR.—A new electric elevator is to be installed in the city hall at Grand Rapids, Mich. The Common Council has authorized its purchase.

Financial Intelligence.

THE WEEK IN WALL STREET.—Strength and activity characterized the stock market, the centre of interest being almost entirely in the manipulation of such specialties as Reading, Smelting and American Locomotive, in which, as well as in certain other industrials and neglected railroad shares, new price records were established. National Lead, a hitherto neglected specialty, attracted attention, it being claimed that the deal by which it is to be combined with other lead interests is likely to prove successful. Early in the week some portions of the list developed more or less heaviness, prominent among these being Metropolitan Street Railway and Metropolitan Securities, which seemed to be the most vulnerable of the so-called franchise group, and were for a time boldly attacked by the bear traders on the ground that the municipal campaign now in progress in New York City involves a possibility of serious danger to such organizations. Later on, however, the Metropolitan group recovered ground, apparently on covering by the shorts in them. The quarterly report of the United States Steel Corporation was favorably received, though it did not at first produce any great effect upon the position of the stock; later on, however, United States Steel preferred sold up to 105¾, thus establishing a new high-price record for that security. The electric and traction stocks closed firm and prices were generally higher. Allis-Chalmers, both issues, closed with net gains, at 19⅜ for the common and 62 for preferred, the advances being ⅝-point and 2¾ points, respectively. General Electric ranged between 183½ and 189¾, closing at 186, which represents a net gain of 1 point. Westinghouse gained 5¼ points net, closing at 174. American Locomotive common closed at 68⅝ and preferred at 115½, both being net gains—2⅞ for the former and 1 point for the latter. One hundred and fifty-three thousand and two hundred shares of Brooklyn Rapid Transit were sold at prices ranging between 76 and 77⅞, the closing quotation being 76, an advance of 1½ points. Metropolitan Street Railway is up 2⅝. The lowest figure of the week was 117¾, but much of the loss was recovered, the closing price being 121⅝. Interborough Rapid Transit closed at 210, which is a net loss of 1¾. New York & New Jersey Telephone rights closed at 13. Western Union is a shade higher, closing at 93⅜, and American District Telegraph advanced 5¾, the closing quotation being 43. On the curb, prices showed some strength early in the week, but later eased off in sympathy with stock exchange prices. The heaviest trading was in Chciago Subway, 90,000 shares changing hands on a recovery of about 5 points to above 50. Mackay common shares were very strong with a use of more than 4 points to above 50, with talk of an increase in the dividend. Preferred seemed to be pressed for sale, and closed lower than a week ago. Following are the closing quotations of Nov. 8:

NEW YORK

	Oct. 31	Nov. 8		Oct. 31	Nov.
Allis-Chalmers Co	19⅛	19¼	General Electric	187¾	183
Allis-Chalmers Co. pfd	60	61	Hudson River Tel.	..	..
American Dist. Tel.	39	40	Interborough Rap. Tran.	211	210
American Locomotive	69¾	68⅝	Mackay Cos.	46⅜	48⅝
American Locomotive pfd.	114¾	114	Mackay Cos. pfd.	72¾	73
American Tel. & Cable	92	92	Marconi Tel.	..	..
American Tel. & Tel.	136	136	Metropolitan St. Ry.	119	121
Brooklyn Rapid Transit	75⅝	75⅝	N. Y. & N. J. Tel.	..	..
Electric Boat	30	32	Western Union Tel.	93	93
Electric Boat pfd.	70	70	Westinghouse com.	170½	171
Electric Vehicle	15	15	Westinghouse pfd.	..	..
Electric Vehicle pfd.	23	20			

BOSTON

	Oct. 31	Nov. 8		Oct. 31	Nov. 8
American Tel. & Tel	136¼	136¼	Mass. Elec. Ry. pfd.	56¾	55½
Cumberland Telephone	122¾	122¾	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum.	*248	246	New England Telephone	*136	*136
General Electric	186½	182	Western Tel. & Tel.	13	13
Mass. Elec. Ry.	13	13	Western Tel. & Tel. pfd.	90	89½

PHILADELPHIA

	Oct. 31	Nov. 8		Oct. 31	Nov. 8
American Railways	51	52	Phila. Electric	8¼	8½
Elec. Co. of America	11	11⅛	Phila. Rapid Trans.	27⅛	27⅜
Elec. Storage Battery	82	80	Phila. Traction	..	..
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Oct. 31	Nov. 8		Oct. 31	Nov.
Chicago City Ry.	*206	200	National Carbon	63	34
Chicago Edison	..	..	National Carbon pfd.	116	114
Chicago Subway	..	..	Union Traction	..	..
Chicago Tel. Co	..	..	Union Traction pfd.	..	..
Metropolitan Elev. com.	28	28			

* Asked.

INDIANAPOLIS TELEPHONE SITUATION.—The failure of the Indianapolis Telephone Company to pay, on Nov. 1, the guaranteed quarterly dividend of 1½ per cent on the $400,000 common stock of the New Telephone Company, the "independent" organization, has caused so decided a sensation among those stockholders that an investigation of the affairs of the company will probably follow. It is said that the capital stock of the New Telephone Company was appropriated by the organizers of the company; that no money was ever paid into the company for it, and that it may now be liable to assessment to its full valuation. It is also said by some that the plant is not worth more than its mortgage indebtedness, and that the stockholders have known nothing about the true condition of the company. The public statements on which the stock has been sold, it is charged, have shown the mortgage indebtedness of the New Telephone Company as amounting to only $800,000, consisting of a $500,000 first mortgage bonds and $300,000 second mortgage bonds, while it is now discovered there is a $150,000 third mortgage, and on top of all this between $315,000 and $350,000 floating indebtedness. It is also charged that the published statements of the liabilities of the company have not shown the interest on this third mortgage and the floating indebtedness. It is also said that the company has been forced, in order to pay dividends for some time, to continue and increase indebtedness. The control of the Indianapolis Telephone Company has passed recently into the hands of St. Louis capitalists, as noted already in these columns.

KEYSTONE TELEPHONE BONDS.—In their bond circular, Fisk & Robinson have the following to say in regard to the Keystone Telephone Company, of Philadelphia: "In response to the demand for additional telephone service, work of extension has been rapidly pushed. Additional conduits have been laid in the northwestern part of the city and in the Manayunk district, and extensions will be made to Chestnut Hill. A large force of men are already at work in West Philadelphia and the switchboard of that exchange has been extended. The West Philadelphia section has been built up so rapidly that the conduit system will have to be extended from the present terminal, which is about Fiftieth Street, west on all the principal thoroughfares to City Line. Nearly $200,000 worth of additional cable has been ordered, and about two-thirds of it has been installed in the conduits and will be put in service at an early day. The Keystone State Telephone & Telegraph Company is also doing a great deal of extension work in the surrounding counties. A line has been completed to Newtown, Bucks County, and a new exchange installed at that place. Three additional exchanges at suburban points will shortly be established."

HUNGERFORD ELECTRIC & MFG. CO.—Schedules in bankruptcy of the Hungerford Electric & Manufacturing Company, insulated wire, at 156 Fifth Avenue and Belleville, N. J., show liabilities of $56,339, of which $25,109 are secured, $1,001 taxes and $640 wages. The nominal assets are $84,538, consisting of factory at Belleville, $47,314, mortgaged for $19,000; machinery, $32,973, chattel mortgaged for $4,775; furniture and fixtures, $4,051, and materials, $200. Among the creditors are the Rubber Goods Manufacturing Company, $19,636, secured by mortgage on factory; Charles E. Parker, E. B. Smith and S. G. Goodwin, jointly, $5,473, secured by chattel mortgage; E. B. Smith, attorney for O. T. Hungerford, $11,941 for salary, loans and commissions, the amount in dispute; Edward B. Smith, $5,249, and William T. Redfreed, $2,478.

WESTERN TELEPHONE.—The preferred stock of the Western Telephone Company has recently been sold down to 91, against a high price of 104 last February. The common has declined from 22½ to 14. There is $16,000,000 of each issue outstanding. While there has been no very heavy selling pressure, still there has been an absence of any buying orders, and the market for both common and preferred has been very narrow. The decline is believed to foreshadow the early issue of new securities.

ABSORPTION BY THE BELL.—Authentic announcement was made November 3d that the Missouri and Kansas Telephone Company has absorbed the Southwest Telephone Company's lines. The purchased property covers Barry, McDonald, Newton, Jasper, Green and Lawrence counties. Local Manager A. F. Lewis says the Bell people will begin at once improving the main exchanges which are at Carthage, Springfield, Aurora, Monett, Pierce City, Scott City, Neosho and Mount Vernon.

MONTREAL TROLLEYS.—The Montreal Street Railway Company shows for 1905 a gross of $2,707,474, a growth from 1902 of nearly $700,000. The net for the year is $1,056,908, and after charges of $363,739 and dividends of $691,667, a balance is left of $1,502. The number of passengers carried was 66,631,206. The bonds amount to $2,509,000, and the capital stock is $7,000,000.

DIVIDENDS.—Pratt & Whitney declared the regular preferred quarterly dividend of 1½ per cent, payable Nov. 15. Niles-Bement-Pond Company has declared the regular preferred 1½ per cent. quarterly dividend, payable, Nov. 15. The directors of the New York Consolidated Gas Company have declared the regular quarterly dividend of 2 per cent., payable Dec. 15.

SOUTHERN NEW ENGLAND TELEPHONE.—The stockholders of the Southern New England Telephone Company have approved the resolution to increase the company's capital stock from $5,000,000 to $10,000,000.

WESTINGHOUSE MACHINE.—The stockholders of the Westinghouse Machine Company will hold a special meeting on Dec. 23 to vote on an increase of capital stock from $5,000,000 to $10,000,000.

General News of the Week

The Telephone.

MOBILE, ALA.—The Home Telephone Company has absorbed the Eastern Shore Telephone Company and will immediately spend $20,000 in improving the system.

EARLE, ARK.—The Earle & Tyronza Telephone & Telegraph Company has been formed with a capital stock of $5,000. Incorporated by John F. Rhodes, president, and John M. Taylor, secretary.

CASTLEDALE, CAL.—A franchise has been granted by the County Commissioners to R. G. Miller and associates for a telephone system. This concern recently absorbed the Carbon and Emery county line, and is to make connections with the Rocky Mountain Bell system which now extends as far east as Colton.

OAKLAND, CAL.—The Pacific States Telephone Company will lay its wires in conduits in this city, at a cost of $120,000.

BOISE, IDAHO.—The Star Independent Telephone Company has been organized with a capital of $10,000 by H. D. Andrews and J. S. Wehr.

VIENNA, ILL.—The Interior Telephone Company has increased its capital from $300 to $50,000.

NEW MILFORD, ILL.—F. E. Pell and Arthur Chase are reorganizing an independent telephone company here. The capital stock will be $5,000.

MOLINE, ILL.—The Central Union Telephone Company contemplates placing its wires underground in the business section of the city.

EPSTER, N. Y.—The Foster Valley Telephone Company has been formed with a capital of $1,500, by Vernon Cornell and Albert Mason.

CHICAGO, ILL.—The city has abandoned its plans for the municipal ownership of the telephones used by the police and fire departments, and City Electrician Carroll will award a contract to the Chicago Telephone Company for the rental of instruments. The company, however, will lose $1,600 a year through the city's threat to purchase its own supplies, charging only one-third the former rental.

MARION, IND.—O. L. Barger has petitioned the Marion Board of Public Works for a franchise to establish an automatic telephone system in this city.

BROWNSTONE, IND.—The Brownstone Telephone Company has closed a deal with the Union Telephone Company, by which it has placed in service over 60 additional telephones.

BENGAL, IND.—The Bengal Telephone Company has succeeded in its effort to raise enough money to put in a trunk line from Needham to Marietta, and a first-class switchboard which will soon be in operation.

OSCEOLA, IND.—The Dunlap Telephone Company has filed articles of incorporation with the secretary of state. The capital stock is $20,000. Marion D. Pancake, Wm. D. Kauffman and others are the incorporators.

RICHMOND, IND.—The Converse Telephone Company, which for the past five years has been a sub-licensee of the Central Union Telephone Company, has severed its connection with the Bell interests and now connects only with the independent systems.

MONTICELLO, IND.—An agreement has been ratified between the Monticello Telephone Company and the Yeoman Telephone Company, which provides for the connection of the two exchanges. The new toll lines necessary to connect both companies will be built at once.

TERRE HAUTE, IND.—The Citizens' Telephone Company has ordered plans and will soon ask for bids for the construction of a large exchange building. The controlling interest of this company has been secured by the Kinloch people of St. Louis, and the new management announces that other improvements will be made and new equipment installed.

SOUTH BEND, IND.—It having been reported about the city that the Home Telephone Company intends raising the rates for service in Mishawaka, President Theodore Thorward, of South Bend, has stated emphatically that the Home Company has never had the remotest idea of raising local rates here, and even if it desired to do so, the franchise granted by the city would not permit any advance in rates.

WATERLOO, IND.—The Central Union Telephone Company is extending its toll lines north from this place. The company will probably take in the Farmers telephone line at Angola, as it is considered to belong to the Bell telephone syndicate. The extension of these lines will greatly improve the service of the Central Union in this section.

TERRE HAUTE, IND.—The report first given out to the effect that the Toledo and St. Louis syndicate, which secured control of the Indianapolis Telephone Company and the New Long-Distance Telephone Company, had also taken over the Citizens' Telephone Company of Terre Haute, is not true. On the contrary the Kinloch interests alone has secured the majority of the stock and the property has passed to its control. The capital stock will be increased to $375,000 and improvements costing $250,000 will be made. A special building for exchange purposes will be erected. The company was reorganized on Oct. 28. C. M. Foster, president of the Kinloch Company, of St. Louis, was elected president; W. P. Ivans, formerly president, was made vice-president and Roy McCann, secretary of the Kinloch, was made secretary-treasurer of the Terre Haute Company.

MUSKOGEE, I. T.—The Pioneer Telephone and Telegraph Company, with headquarters in Muskogee, has added another big territory exchange to the number it owns and controls in the two territories. This is the South McAlester exchange, which also includes the exchanges in the smaller mining towns of that district. The Pioneer Company has purchased nearly all the telephone exchanges and toll lines in the two territories and is rapidly absorbing what is left and merging them into the big company.

LONG GROVE, IA.—The Long Grove Mutual Telephone Company has been formed, with a capital of $10,000, by R. K. Brownite, president, and Dr. G. B. Maxwell, secretary and treasurer.

ESTHERVILLE, IA.—The Western Electric Company is to build a line to Emmetsburg.

BURLINGTON, IA.—Great interest has been aroused here by the fight between Mayor Caster and the members of the City Council on a proposition to permit the Iowa Telephone Company to put its wires underground. The company's franchise ran out last year, and the Mayor contends that the Iowa Telephone had no legal existence in Burlington, and that the city could not legally grant it anything. The company claims that its franchises is practically a perpetual one.

ROCKFORD, ILL.—The Winnebago County Telephone Company has completed the rebuilding of its line here. Cables have been put in to do away with some of the single wires and all the latest improvements made.

SHEPHERD, MICH.—The Union Telephone Company is extending its lines. Orders are coming in for extensions and for new telephones faster than they can be filled.

BRAINERD, MINN.—The Morrison County Telephone Company will build a line to St. Wendall.

SLEEPY EYE, MINN.—The Sleepy Eye Telephone Company is extending its rural lines in various directions.

FORSYTHE, MONT.—The Forsythe Telephone Company has been formed. The capital is $50,000. The incorporators are: J. E. Edwards, C. H. Blair and others.

PLEASANT HILL, MO.—The Pleasant Hill Hotel, Light and Water Company, of Pleasant Hill, has been incorporated with a capital stock of $40,000, all paid. The incorporators are John Holloway, J. F. Wilson, Ben D. Stephens, Edwin Foote, J. M. Elliot, Wm. H. Allen and others.

ST. LOUIS, MO.—The State Board of Equalization has made a large reduction in the assessed valuation of the properties of the Bell and Kinloch telephone companies this year, as compared with the levy in 1904. In 1904 the valuation of the property of the Bell Telephone Company, as returned by the board, was $1,241,162.26; in 1905, the valuation is $654,780.26, a reduction of nearly 50 per cent. The Kinloch's assessment in 1904 was $700,000 and in 1905 it is $584,850.

ST. LOUIS, MO.—The Missouri & Kansas Telephone Company showed a gain of nearly 14 per cent in the number of subscribers during the first six months of the present year. On January 1, 1905, the company had a total of 35,570 subscribers. On July 1 the number had increased to 38,606. In figuring the actual gain, however, there should be added to the 38,606 subscribers as of July 1, 2,896 subscribers, who were transferred to the Pioneer Telephone Company at the time the Missouri & Kansas sold its Oklahoma and Indian Territory field to that company. The total increase would, therefore, be 5,932 subscribers in six months.

YERINGTON, NEV.—The Yerington Electric Company will extend its telephone line from Yerington south at an early date. The line will be run up to Plummers and Modryke and then on to Smith Valley. Eventually it will be continued to Pine Grove and Rockland, and probably to Dayton. From Smith Valley the company operating in that place will build to Bodie, Bridgeport and Aurora, and the line from Bodie to Hawthorne will be connected with the line from Sodaville to Tonopah.

TONOPAH, NEV.—The Southern Nevada Consolidated Telephone & Telegraph Company will erect a new exchange in Goldfield.

PERTH AMBOY, N. J.—The Perth Amboy city government has just signed a contract with the New York and New Jersey Telephone Company for a private telephone line from Perth Amboy to the City Pumping Station, at Runyon, the distance being 8 miles. There were two bidders for this work—the Hudson & Middlesex Telephone Company and the New York and New Jersey Telephone Company. The Hudson & Middlesex Company, however, were unable to fulfill their bid, owing to their inability to obtain right of way to set poles from Perth Amboy to Runyon. The New York & New Jersey Company was able to obtain the necessary right of way, and is now setting the poles.

GOUVERNEUR, N. Y.—The proposition to issue $25,000 bonds for a municipal telephone system is to be submitted to a vote.

UNDERWOOD, N. D.—A franchise has been granted the Missouri Valley Telephone Company.

GRANVILLE, N. D.—The Northwestern Telephone Company has been granted right of way in Granville.

CARRINGTON, N. D.—The North Dakota Central Telephone Company has been incorporated with $50,000 capital stock.

NEW LEXINGTON, OHIO.—The Perry County Telephone Company is preparing to rebuild its plant at this place. The directors held a meeting here recently and decided to spend at least $8,000 on the new plant. All the wires inside the corporation will be cabled. There will be over two miles of cable that will carry 400 single wires. The new exchange will be in the Weiland building.

FORT LAWN, S. C.—A company has been organized with L. A. Abernathy as president and M. Chapman, manager, to construct a local telephone system.

CUSTER, S. D.—The Eldorado Mutual Telephone Company has been formed with a capital of $25,000. It was incorporated by Wm. Nevin and T. V. Carock.

RAPID CITY, S. D.—The Rapid Valley Telephone Company has been incorporated with a capital of $10,000.

BUTLER, S. D.—The Butler Telephone Company has been organized with a capital stock of $10,000, by L. C. Goodel, president, and N. E. Bjerke, secretary.

SHAMROCK, TEX.—The Walker Telephone Company, of Shamrock, has been incorporated with a capital of $10,000. The incorporators are J. E. Walker, Barnett Blossom and Rea Blossom.

PULASKI, TENN.—Much comment has been raised here by a called meeting of the Board of Mayor and Aldermen which concluded a contract with the Cumberland Telephone Company for the payment of $300 per year until February 11, 1910, for the exclusive franchise of the streets. The Board of Aldermen passed on second reading a bill to grant to the Long Distance Telephone Company a franchise along with the Cumberland. This was referred to a committee and it was resolved to hold an election to ascertain the sentiment of the people as to the granting of a new franchise. The proposition of the Cumberland company was submitted in private to the Aldermen, and at a private meeting was accepted, and was afterwards ratified at a formal public meeting of the Aldermen.

LITTLETOWN, VA.—The Union Telephone Company has completed its organization, the officers being: President, L. Delbrugge, and secretary, Chas. Stumm.

CHEHALIS, WASH.—The Sunset Telephone Company will make extensive improvements to the local system here.

WALLA WALLA, WASH.—Mr. Charles E. Sumner has applied to the city council for a telephone franchise in this city.

DEEP RIVER, WASH.—The North Shore Telephone Company, of Deep River, has been incorporated. The capital stock is $1,500. The incorporators are W. N. Meserve, William Anderson, P. J. Boix and A. Olsen.

NELSON, WIS.—The farmers of this section have purchased the Dr. Asbury telephone line and will form a stock company and extend the line.

CUMBERLAND, WIS.—The Cumberland Telephone Company has changed hands. The service will be extended and improved.

NORTH MILWAUKEE, WIS.—A local telephone exchange is being built by the Wisconsin Telephone Company at North Milwaukee, like those at West Allis and Wauwatosa. There will be 100 subscribers at the start. No toll charge will be made to North Milwaukee as in the past. Persons within one and one-half miles will be given telephone rates the same as those in Milwaukee.

KENOSHA, WIS.—It is stated that the Wisconsin Telephone Company may retire from Kenosha within a short time and leave the field to an independent company. Negotiations are now pending between the officials of the Wisconsin Company and those of the Citizens' Company of this city for a consolidation of the two plants under a new holding company. The price of the combined plants is said to be $200,000. The deal will eliminate telephone competition in Kenosha and will give the holding company a business of more than 1,800 subscribers. It is understood that the company will continue the long distrance service by the Wisconsin company's wires.

PORT ARTHUR, ONT.—The ratepayers have passed a by-law to expend $15,000 on improving the municipal telephone service.

MONTREAL, QUE.—The Canadian Pacific Railway Company has strung 3,000 miles of telegraph wire during the present year, half of which was copper.

LAS CRUCES, N. M.—A permit to do business in Texas has been granted the Texas and New Mexico Telephone Company of Las Cruces, N. M., having a capital stock of $15,000 and principal Texas office with the Southwestern Telegraph & Telephone Company, at El Paso.

Electric Light and Power.

SPRINGDALE, ARK.—Spencer Owen has secured the franchise for constructing an electric light plant.

LOS ANGELES, CAL.—The City Council has approved a contract with the Los Angeles Gas and Electric Company for lighting the streets of this city for the next three years at a cost of $75.60 a year for each light. The present price is $81.

RANDSBURG, CAL.—The Kern Rand Company, recently incorporated in Arizona, and with offices at Los Angeles, Cal., is planning the erection of a power house on the south fork of the Kern River, and the construction of an electrical transmission line to Randsburg.

MERCED, CAL.—The Merced Falls Gas & Electric Company has purchased 80 acres of land in Mariposa County, on which a power plant of 5,000 horse-power capacity will be built. From this plant power will be transmitted to Merced and vicinity over a line about 70 miles long.

LOS ANGELES, CAL.—A corporation is being formed for the purpose of erecting a large power plant. The company will build dams and lay pipes for the distribution of 7,500 inches of water to certain points. The plant is to be constructed at Victor Narrows, and will develop 15,000 horse-power.

MOUNTAIN VIEW, CAL.—A committee consisting of W. A. Clark, D. B. Frink and O. Becker has been appointed by the Board of Trade to take preliminary steps looking to the establishment of a municipal light and power plant at this place. Power is at present supplied by the United Gas & Electric Company, of San Jose.

SAN ANDREAS, CAL.—The Supervisors have accepted the bid of the Sierra Nevada Water & Power Company for a 50-year franchise, to establish electric pole lines and conduits over the county. The company is constructing a dam near Railroad Flat, which is to impound the waters of two rivers. Work here is under the personal supervision of C. Martel, the president of the company.

GILROY, CAL.—Engineer Thirber, of San Jose, who was employed by the City Council to furnish an estimate of the cost of an electric lighting plant, has submitted an estimate calling for $14,500. This is somewhat in excess of the funds available, but the council has decided to advertise for bids for the construction of the plant according to specifications and for the material needed for transmission lines.

RED BLUFF, CAL.—Geo. W. Bush, of Redding, has filed claims on 18,000 miner's inches of water in Battle Creek below the mouth of Baldwin Creek for the purpose of generating electric power. Water is to be conducted in a canal 25 ft. wide and 6 ft. deep, and in wooden pipes 10 ft. in diameter, for a distance of six miles on the north side of Battle Creek to the vicinity of Horsheshoe Bend.

CALISTOGA, CAL.—The Calistoga Electric Light & Power Company has filed articles of incorporation and proposes to establish an electric lighting and power plant that will supply all of its needs and those of the big wineries in this vicinity. The articles also provide for the establishment of a gas plant. The capital of the company is $20,000. The directors are G. W. Cutler, E. L. Armstrong and Mrs. Edna Brown, of Calistoga, and District Attorney Reymond Benjamin, of Napa.

VISALIA, CAL.—The Commissioner of the U. S. Land Office has affirmed the decision of the register and receiver of the Visalia office in the case of A. G. Wishon, protestant and adverse claimant, against the Globe Light & Power Company, the applicant for a power site, transmission line, conduit, etc., in favor of the defendant power company. The action was brought by Wishon to prevent the Globe Light & Power Company from securing a permit to build a power plant above Springville, the application of Wishon for the same site having previously been rejected, and that of the Globe Light & Power Company approved.

SAN FRANCISCO, CAL.—The Sierra Nevada Water & Power Company's deed of trust has been recorded whereby it mortgages to the Union Trust Company, of San Francisco, all of its property, including water rights, franchises, etc., in Calaveras County and elsewhere in California. The Union Trust Company has guaranteed the payment of the Water & Power Company's 20-year 5-per cent bonds, issued last month, to the amount of $3,000,000.

SAN FRANCISCO, CAL.—The Oro Water, Light & Power Company, J. W. Goodwin, president, has closed a contract with the General Electric Company for two 1,000-kw, 3-phase generators for its electric power plant which is to transmit current 16 miles to Oroville, Cal. The Schaw-Batcher Company has secured the contract for 6,000 ft. of steel pipe line from 44 ins. down to 30 ins. in diameter. Each unit will consist of two water wheels, one at each end of a shaft with the generator at the center, so that either one or two wheels can be used for driving. Cory, Meredith & Allen are engineers for the company.

SAN FRANCISCO, CAL.—The management of the Platt Iron Works Pacific Coast district agency has received reports of very successful tests of the new water wheeel now in operation at the Seattle-Tacoma Power Company's plant at Snoqualmie Falls, Wash. The Type B. Victor turbine wheel direct connected to a Westinghouse 5,000-kw, 3-phase generator tested at full gate developed 8,000-kw at the switchboard. This makes the capacity of the wheel 11,200 hp when operated at 300 r.p.m. under a head of 270 ft. of water This increase of capacity will be of much benefit to the company's service in the Puget Sound cities.

SAN FRANCISCO, CAL.—The consummation of the deal by which the Pacific Gas & Electric Company is to take over the California Gas & Electric Corporation and the San Francisco Gas & Electric Company is now assured, as 105,656 shares, the requisite two-thirds of the issued stock of the latter company, has been placed in escrow with the Union Trust Company. The minority stockholders will have until Nov. 15 to sign the agreement and take their $25 per share in cash and $65 per share in 5 per cent 30-year general mortgage and collateral trust gold bonds of the new company. An official says that the change of management of the San Francisco Gas & Electric Company will take place Jan. 1, 1906.

GUILFORD, CONN.—Preliminary operations have been inaugurated for an electric light circuit to Madison for which an independent power house will be erected in the near future, the location of which is not definitely decided upon.

HARTFORD, CONN.—The entire electrical system of the city is about to be changed over from direct to alternating current, and all the power will be supplied from the new station at Black Rock. The company has gradually been changing over the system until now only the central section of the city is operated from the steam station in Chestnut Street. When the entire system is changed it will mean the abandonment of the Chestnut Street power station as a source of supply.

NEW HAVEN, CONN.—The committee on public lighting adopted a resolution to be presented to the Board of Aldermen that the committee be instructed to confer with the United Illuminating Company, which has been furnishing the lights, and obtain terms for the renewal of the existing contract for electric arc street lights, expiring December 31. The resolution also instructed the committee to hold a public hearing in the matter and report for the consideration of the Board of Aldermen a draft of the contract between the city and the United Illuminating Company.

ZIONSVILLE, IND.—The Zionsville Lumber Company has decided to construct an electric light plant.

GENEVA, IND.—W. R. Thurston, of Bern, who recently secured a franchise to construct an electric light plant in Geneva, has decided to organize a stock company.

BURT, IA.—The citizens of this city have voted for an electric light plant and a water works system.

HAMILTON, MD.—The Hamilton Water, Light & Power Company has been incorporated with a capital of $35,000 to supply water and light to Hamilton and Lauraville.

FALL RIVER, MASS.—The Fall River Electric Light Company is preparing plans for a power station to be located on the easterly shore of Taunton River. Harry Bottomley is superintendent.

WORCESTER, MASS.—The new 105-kw. generator for the power laboratory at the Worcester Polytechnic Institute has been received from the Westinghouse Company. It is for direct connection to the 175-hp. Westinghouse engine, which is now being set up. This unit is the first to be installed for the new service plant at the Institute.

EVANSVILLE, IND.—The Evansville Gas & Electric Light Company has made contracts with interurban lines entering Evansville to furnish all necessary power. The company will expend about $150,000 on improvements to its power plant.

GRAND RAPIDS, MICH.—The Board of Public Works has awarded the contract for the equipment for the new municipal lighting plant to the Fort Wayne Electric Works, of Fort Wayne, Ind. The contract provides for a 105-kw generator and a 14 x 15 Skinner engine. The price for the two is $3,554.

LAKE LINDEN, MICH.—The Calumet & Hecla Copper Mining Company is building a power plant here of 10,000-hp capacity. A transformer house is being built at Calumet. Power for the mines, shops and waterworks will be distributed from this transformer house, to which power will be delivered at high voltage.

DILLON, MONT.—The Dillon Electric Light & Power Company has begun the reconstruction of its entire system in this city. The steam plant is to be improved at a cost of $6,000 and the transmission line between the plant and the city, which now consists of No. 8 copper wire, is to be replaced by No. 4 copper wire.

FREMONT, NEB.—It is proposed to install three new boilers and make other improvements at the municipal electric light plant.

KEARNEY, NEB.—Col. F. W. Blees has disposed of his stock in the Northeastern Electric Heat & Power Company and retired from the business November 1. The new owners of the company are gentlemen who are largely interested in like enterprises in various places and are thoroughly experienced and have ample capital. The name of the company remains the same. William E. McCully, of Macon, Mo., is secretary, treasurer and general manager of the company. He will spend about half of his time in this city, notwithstanding his extensive interests elsewhere. He is secretary, treasurer and general manager of the following corporations: Macon Gas and Electric Light Company; Marshall (Mo.) Electric Light and Power Company; Palmyra (Mo.) Light and Water Company. The new president of the company is Thomas E. Wardell and the vice-president is Fred H. Tedford. The resident manager will be S. J. Duncan. L. E. Watson, who has been manager of the plant under the ownership of Col. Blees, has accepted the position of manager of the Beatrice (Neb.) electric plant.

GOLDFIELD, NEV.—The California-Nevada Mining, Milling & Power Company is said to have secured all the water rights along Pine Creek in Inyo County, Cal., and will erect an electric power plant near Alvord, Cal., from which point a transmission line will be constructed to the Bullfrog mining district at a cost of about $150,000.

ROANOKE RAPIDS, N. C.—Engineers are now preparing plans for the power house and electrical installation of the Roanoke Rapids Power Company. It is proposed to construct a dam across Roanoke River at this point, which for the first development will give the company about 9,500 horsepower. Later it is proposed to raise the dam so as to give about 25,000 horse-power for 11½ hours per day. C. P. E. Burgwyn, Richmond, Va., is the engineer in charge.

FARGO, N. D.—The gas and electric light plant at Fargo has been sold by Mainland Bros., to New York capitalists.

OYSTER BAY, N. Y.—After a fight that has lasted for years, the Nassau Electric Light and Power Company has absorbed the Oyster Bay Light and Power Company. Interested in the Nassau Company are Edwin D. Morgan, Clarence H. Mackay, Percy Chubb and other well-known men. The Oyster Bay company made a hard fight to keep the Nassau Company out of its territory, but at last had to succumb. The struggle between the rival companies was accompanied by many lively incidents. The Nassau people would start in to put up poles at night, but the local managers were always on the watch, and lawyers were sometimes routed out of bed at midnight to give an opinion as to the legality of the Nassau company's action. Men were sent out by the local company to chop down poles when it was thought they had been erected in violation of the law, and in some cases men employed by the Nassau company climbed to the tops of the objectionable poles and stayed there, defying their opponents to cut down the poles.

JUNCTION CITY, ORE.—J. N. Fellener is preparing to erect an electric light plant at this place.

SALEM, ORE.—The Calbe Cove Power Company, of Sumpter, has filed articles of incorporation, with $100,000 capital. O. C. Wright, T. C. Gray and E. Ray Jones are the incorporators.

JUNCTION CITY, ORE.—The Gilmore Water-Power Company has been incorporated here by S. P. Gilmore, Emma Gilmore and Eliza Gilmore for the purpose of establishing water works for irrigation and other purposes.

JAMESTOWN, OHIO.—The city council has granted a franchise to the Jamestown Electric Light Company, which has been lighting the streets without a franchise.

CLEVELAND, OHIO.—The city council of Cleveland has adopted resolutions to submit to referendum votes general franchises to two lighting, heating and power companies, to compete with the present company.

BAMBERG, S. C.—It was voted on October 24 to issue $15,000 bonds for the construction of an electric light plant. The Board of Public Works will have charge of the construction.

NASHVILLE, TENN.—The Chattanooga & Tennessee River Power Company has amended its charter by increasing its capital stock from $3,000,000 to $3,500,000.

WALLA WALLA, WASH.—The Northwestern Gas & Electric Company has decided to install a new power plant on the upper Walla Walla River.

BALLARD, WASH.—The entire plant and franchise of the Ballard Electric Company has been sold to the Seattle Electric Company, and it is stated that many improvements and additions will be made to the plant.

PORT WASHINGTON, WIS.—An ordinance was passed and approved on Oct. 23 providing for the construction of an electric light plant and water works. Wm. A. Tholan is city clerk.

PEMBROKE, ONT.—The Pembroke Electric Light Company will increase its capital stock from $50,000 to 150,000, and will enlarge its plant.

The Electric Railway.

LITTLE ROCK, ARK.—Arrangements have been completed for the financing of the Little Rock-Hot Springs interurban project and officials of the company declare that the actual work of construction will probably begin by Jan. 1.

PALO ALTO, CAL.—Arthur Crane has applied to the Town Trustees for a 35-year franchise for an electric railway through the principal streets.

SAN DIEGO, CAL.—Property recently purchased in the San Luis Rey section is said to have been secured in the interest of H. E. Huntington, who is desirous of obtaining control of the water power on the San Luis Rey River. Practically the entire right of way for the proposed railway from San Diego to Santa Ana has already been secured.

AVA, ILL.—St. Louis capitalists have organized a company to construct an electric railway from Carbondale to East St. Louis.

EAST ST. LOUIS, ILL.—The Electric Railway Express Company, of St. Louis, Mo., with a capital stock of $100,000, has been incorporated to do business in Illinois, with a capital stock of $50,000.

SPRINGFIELD, ILL.—The secretary of state has issued a license to incorporate the Decatur, Sullivan & Mattoon Transit Company. The principal office is to be at Mattoon. The capital stock is nominally $25,000. The incorporators and first board of directors are: R. J. M. Clokey and J. H. Culver, Decatur; George B. Spitzler, Mount Zion; John R. Hamilton and Edward C. Craig, Mattoon.

MARION, IND.—W. B. Dodds is promoting an electric railway between Marion and Union City.

SCOTTSBURG, IND.—The town board has granted a franchise to the Louisville & Indianapolis Traction Company for a right of way through the town.

ELLETSVILLE, IND.—The Northwestern Indiana Interurban & Street Railway Company has been incorporated with a capital of $10,000, by Franklin Knight and Edwin Knight.

FORT WAYNE, IND.—Complete service between this city and Lima, O., has been inaugurated by the Fort Wayne, Vanwert & Lima Traction Company. The line is 60 miles long. The power will be obtained from the power station of the Western Ohio Traction Company at St. Marys, Ohio, until the new Fort Wayne power station is completed.

INDIANAPOLIS, IND.—The officials of the Union Railway Company are letting contracts for the improvement work of the Union Station, which is to cost approximately $75,000. The contracts for the electrical work and the heating and lighting are the most important and expensive. The company expects to erect the heating and lighting plant in three months.

PERU, IND.—The franchise granted to the Winona-Peru Traction Company is so unsatisfactory that the company has declined to accept it. The company objects to the provision compelling the traction company to light and sprinkle the streets over the route of the line. The company has notified the council that unless a more liberal franchise is granted it will build its line either to Wabash or Logansport. The franchise has been referred back for further consideration.

CHICKASHA, I. T.—Application has been made to the City Council for a franchise for an electric street railway system. J. G. V. Redmon, W. T. Crosless, W. S. Jones and W. G. Shannon are named as the grantees.

OSAWATOMIE, KAN.—The City Council has passed an ordinance granting an electric railway franchise to W. H. Murphy, of Osawatomie.

TEXARKANA, KAN.—The Texarkana Electric Street Railway, owned and operated by the Texarkana Light and Traction Company, has gone into the hands of Col. E. J. Spencer, of St. Louis, as receiver, on an order issued by Judge Rogers of the United States District Court, at Fort Smith. The railway, it is said, has not paid any interest on the money invested during the last 18 months.

TOPEKA, KAN.—A charter has been granted to the Falls City, Sycamore Springs, Sabetha & Southwestern Railroad Company, capitalized at $100,000. The company proposes to build an electric railway from Sycamore Springs to Topeka. A line is also proposed to run in a westerly direction from Sycamore Springs to the west line of the state. The directors and incorporators are: Samuel Kimmel, E. S. Towle, W. H. Crook, W. E. Dorrington, Albert Maust, J. H. Miles and Edwin A. Towle, all of Falls City, Neb.; E. V. Kauffman and H. Reeding, of Sabetha; W. A. S. Bird, of Topeka; J. T. Slusher and Roy Hasseltine, of Sabetha; George Boone, Jr., of St. Joseph, Mo., and George L. Campen, of Lincoln, Neb.

BOSTON, MASS.—The Western Massachusetts Street Railroad Company has petitioned the Railroad Commissioners for the construction of its road. The company's capital stock is also $300,000.

BOSTON, MASS.—The Railroad Commission has approved the extension of the Boston Elevated Railway Company's tracks from the Mount Auburn district along the westerly shore of Fresh Pond and in Concord Avenue to Belmont.

BOSTON, MASS.—The Railroad Commissioners have given their approval to the lease of the railway franchise and property of the Springfield & Eastern Street Railway to the Springfield Street Railway Company, a corporation owned by the Consolidated Railways Company.

FREDERICK, MD.—The directors of the Washington, Frederick & Gettysburg Railway Company has organized by electing the following-named officers: President, D. Columbus Kemp; vice-presidents, D. C. Wine-Brener and Alexander Ramsburg; secretary, Charles C. Waters; treasurer, Dr. F. B. Smith; attorney, William H. Hinks.

BOSTON, MASS.—The Nahant & Lynn Street Railway Company has petitioned the Railroad Commissioners to issue $100,000 mortgage bonds to pay for the construction and equipping of its road. The company's capital stock is $100,000. It has no funded debt.

BATTLE CREEK, MICH.—The Battle Creek & Southeastern Railway Company has been incorporated, with a capital stock of $500,000 for the purpose of building a line of road from Coldwater to Battle Creek, a distance of about 30 miles, to be operated by any motive power other than steam engines. The general offices of the company are at Battle Creek, Mich., and the directors are William E. Ware and Edward F. Pangburn, of Battle Creek, and Howard H. Zigler, Martin E. Murphy and Charles E. Miles, of Columbus.

CARTERVILLE, MO.—At the annual meeting of the Southwest Missouri Electric Railway Company, held in Carterville, officers were re-elected as follows: President, A. H. Rogers; vice-president, Samuel Reynolds; secretary, E. Z. Wallower; treasurer, Charles Schifferdecker.

ST. LOUIS, MO.—The franchise of the St. Louis County Street Railway Company, which was granted in September, 1902, for a line out the Olive Street road to Creve Coeur Lake, was declared forfeited by the county court last week. The forfeiture releases $1000 which the company posted as a guarantee of good faith. This reverts to the county. Judge Henry Bond was president; George Autenreith, secretary, and John Dolan, treasurer of the company. An application of the St. Louis, Fern Ridge & Western Railway Company, which was filed several weeks ago, asking for permission to build along practically the same as the forfeited St. Louis County Railway Company's route is now pending before the court.

NEW YORK, N. Y.—The annual report of the American Light & Traction Company for the year ending Sept. 30 shows an increase in gross earnings of $166,000 and in profits of $165,000. The dividends paid during the year by the company involved $731,000, an increase of $97,000 over the previous year. The surplus was $496,936, an increase of $67,720.

BUFFALO, N. Y.—At the annual meeting of the International Traction Company, held recently, the following directors and officers were elected: Directors: Dewitt Cuyler, N. Robinson, T. E. Mitten, G. N. Boissevain, P. White, A. Robinson, H. J. Pierce, G. B. Schley and A. H. Payne. President, H. J. Pierce; vice-president, Nelson Robinson; secretary and treasurer, F. L. Slocum; auditor, E. Emmerich.

MARYSVILLE, OHIO.—Indications are now that the Columbus, Urbana and Western Electric Road, which is in the hands of the Schoepf syndicate, will be built through Union County.

CLEVELAND, OHIO.—The Northern Ohio Traction & Light Company has placed a contract with the General Electric Company for a 2,000-kw. Curtis turbine and for a 1,000-kw motor-generator set. A substation outfit will be installed in the present station at Bedford.

OKLAHOMA CITY, OKLA.—The Oklahoma Traction Company, of which C. V. Eggleston is president, has been granted a franchise by the City Council to build an interurban line from this city to Norman and thence to Shawnee.

PORTLAND, ORE.—The Portland Railway Company, which has taken over the properties of the Portland Consolidated Railway Company, has organized as follows: President and general manager, F. I. Fuller, Portland; vice-president, E. W. Clark, Philadelphia; secretary and assistant treasurer, G. L. Estabrook, Philadelphia; treasurer and assistant secretary, C. N. Huggins, Portland; assistant manager, F. S. Drake, Portland; superintendent of transportation, F. Cooper, Portland; purchasing agent, J. E. Coldwell.

YORK, PA.—A contract has just been closed between the York Haven Power Company and the Philadelphia, Lancaster & Harrisburg Railway by which the former will furnish power to operate the trolley line now being constructed between those cities.

ALTOONA, PA.—The Southern Traction Street Railway, incorporated in Pennsylvania last March with $250,000 capital stock to build an electric railway from Altoona to Roaring Springs, Pa., 18 miles, has made a mortgage to the Real Estate Title & Trust Company, of Altoona, trustee, to secure an issue of $500,000 6 per cent bonds, dated Sept. 15, 1905, and due 1915, but subject to call in 1910 at 103 at option of company. The officers are: President, F. G. Patterson; secretary and treasurer, F. J. Thompson.

EVERETT, WASH.—Surveys have been started on the proposed Everett & Eastern interurban railway.

ANACORTES, WASH.—E. G. English and others have applied for a franchise for an electric railway to Mt. Vernon.

WELLSBURG, W. VA.—The Wellsburg & Washington Electric Railway Company has been incorporated with a capital of $10,000, for the purpose of building an electric railway from Wellsboro, W. Va., to Washington, Pa. The incorporators are: H. G. Lasear, S. George, H. G. Emery and others.

MADISON, WIS.—The Milwaukee Northern Railroad Company has been organized; capital, $100,000. Incorporated by John E. Uselding, of Port Washington, and John M. Seamann, of Sheboygan. The company intends to build an interurban electric railway from Sheboygan to Milwaukee.

WAUKEGAN, WIS.—It is stated at Waukegan that the Chicago and Milwaukee Electric Railway Company has definitely decided to locate the new half-million dollar power plant at Waukegan, rather than at Kenosha. Work on the plant will not be started until early spring.

MANILA, P. I.—The first annual statement of the Manila Electric Railroad & Lighting Corporation for the year ending Sept. 1, 1905, is as follows: Net earnings, $273,580; interest charges, $123,028; surplus, $150,552. J. G. White & Company, who built and operate the plant, say in connection with this report that while it is an annual one, the earnings up to April 10 were only from the sale of current for power and lighting purposes, as it was not until that date that the street railway was opened to the public. There is still considerable work to do before the railway and lighting system will attain its maximum efficiency, and up to the present time the full mileage of the railway lines is not in operation.

LONDON, ONT.—The London Street Railway Company will expend a large sum in remodeling the system.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Street R. R. Co. has taken over the Winnipeg, Selkirk & Lake Winnipeg Street R. R., and will operate it by electricity. Address Wilford Phillips, manager.

New Industrial Companies.

THE CARTER AUTO-MAGNETIC ORE SEPARATOR COMPANY, of Union, N. J., has been incorporated with a capital of $50,000, by John W. Carter, John E. Winn and August A. Schlegel.

THE STANDARD VITRIFIED CONDUIT COMPANY, of New York, has been incorporated, with a capital stock of $1,000. The directors are W. T. Chapman, Jr., C. R. Ganter and E. H. Sykes, of New York.

THE HALL TELEPHONE MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $50,000. The incorporators are Richard B. Constantine, John P. Gillis and Edward J. Hall.

THE STATE LAND AND POWER COMPANY, of Milwaukee, Wis., has been incorporated with a capital stock of $25,000. The incorporators are Frederick H. Remington, John H. Hurley and Bernard C. Roloff.

THE ELECTRIC TIME SWITCH MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $100,000. The directors are: Renie L. Spiegel, Louis Spiegel and Adolph Fanto, of New York.

THE NEW AMSTERDAM MOTOR COMPANY, of Owego, N. Y., has been incorporated with a capital of $75,000. The directors are Charles Morgan, of South Orange, N. J., and E. F. Terry and Alfred Brotherhood, of New York.

THE FEDERAL ELECTRIC CONSTRUCTION COMPANY, at Brantford, Ont., has been incorporated, with a capital of $40,000 to manufacture meters, motors and all kinds of electrical machinery. Directors, G. H. Kilmer and W. H. Irving, Toronto.

THE NEW YORK DIE COMPANY, of Owego, N. Y., has been incorporated to conduct a business as mechanical and electrical engineers. The capital stock is $25,000. The directors are: L. J. Doolittle and H. W. Forsyth, of New York, and W. A. Babson, of South Orange, N. J.

THE MUNCIE AUTO PARTS COMPANY, of Muncie, Ind., has filed articles of incorporation. It is capitalized at $15,000. The object of the company is to manufacture and supply parts of automobiles, also electrical equipment. Hugh L. Warner, H. L. Hoke and C. P. Quale are the directors.

THE CAPITAL CITY ELECTRIC COMPANY, of Indianapolis, Ind., has filed articles of incorporation with the secretary of state. The capital stock is $5,000. The company proposes to manufacture, buy and sell electrical and steam appliances and machinery of all kinds. Wm. Phipps, L. D. Phipps and A. F. Eggers are directors.

THE NEW GLOBE ELECTRIC MANUFACTURING COMPANY, of Amsterdam, N. Y., has been incorporated to manufacture electrical apparatus. The directors are R. W. Brown, G. I. Herrick, J. E. Larrabee, W. C. Schaufler and Richard Murphy, of Amsterdam, and Eugene Moore and F. D. Oliver, of Johnstown. The capital stock is $250,000.

THE RAIL JOINT COMPANY, of Troy, N. Y., has been incorporated to manufacture rail joints and other railroad appliances. The capital is $100,000. The directors are: L. F. Braine, Percy Holbrook, New York; F. T. Fearry, East Orange, N. J.; G. G. Frelinghuysen, Morristown, N. J.; M. L. Ward, Newark, N. J.; C. P. Wheeler, Chicago, and E. Y. Webber, Stamford, Conn.

THE GRADOLPH-HAHNE ELECTRIC TRANSMISSION COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $10,000, fully paid. It will do a general electrical business, and build, equip and maintain electrical plants. The incorporators are W. F. Gradolph and W. C. Hahne, M. W. Wambaugh, F. D. Hager and H. McK. Wilson, E. R. Rombauer and M. K. Blake.

Legal.

TAX ON POLES.—By a recent decision, the Wisconsin Telephone Company is immune from any effect of an ordinance passed by the Milwaukee common council, which required a license fee of $1 for each of the company's poles set within the city limits on the city street. As the company had 6,900 poles, it meant a tax of $6,900. The company brought injunction proceedings to restrain the city from enforcing the ordinance and the city won in the lower court. The city answered the company's injunctional complaint, to this answer the company demurred and the demurrer was overruled. The company appealed from the order overruling the demurrer to the answer to the complaint. The opinion is written by Justice Kerwin. The question

hinged upon whether the license was an exercise of police powers over the streets, or was an attempt to collect a tax for purposes of revenue. The company operates under a state franchise, and the court held that the license fee was so large as to be plainly for purposes of revenue rather than for police regulation, and therefore reversed the decision of the lower court.

Educational.

UNIVERSITY OF ILLINOIS. — An electrical engineering fraternity, known as Eta Kappa Nu, has been established at the University of Illinois. The qualifications, so far as they may be judged from the personnel of the membership, are evidently interested in the profession as shown by interest in the engineering societies of the University and by practical work in the field of engineering. Members have not been elected before the junior year. The emblem of the fraternity is a conventionalized Wheatstone bridge.

Personal.

A. P. PECK.

MR. A. P. PECK, who is well-known in the Middle West as a successful electrical engineer and salesman of electrical machinery, has joined the Allis-Chalmers Company and will hereafter be connected with the New York office of that company, giving attention particularly to the sale of power and electrical machinery. Mr. Peck is an associate member of the American Institute of Electrical Engineers. He is a native of Chicago. He was graduated from Purdue University in 1892, with the degrees of B.M.E. and E.E. Immediately upon being graduated he secured a place with the World's Columbian Exposition Company, and was identified with the electrical engineering department of the Chicago World's Fair, until January, 1894, as assistant engineer of arc lighting. From 1894 to 1896 he was with the Westinghouse Electric & Manufacturing Company. It was under his supervision during this time that the motors and wiring were installed in the cars of the Chicago City Railway Company. Mr. Peck began his career as a salesman in 1896, and in 1898 he became identified with the manufacture of electric signs, and was engaged in that business for three years thereafter. His next connection was with the engineering department of the Chicago Edison Company, selling power and lighting apparatus. About three years ago, he joined the National Electric Company as electrical sales agent and made Milwaukee his headquarters. His territory included northern Michigan, Wisconsin, Iowa and Missouri.

MR. J. P. MITCHELL has been appointed manager and superintendent of the Gallup Light and Power Company, Gallup, New Mexico.

MR. EUGENE KLAPP has resigned as chief engineer of the Brooklyn Rapid Transit Company to become associated with William Barclay Parsons. The new B. R. T. Chief Engineer is W. S. Menden.

MR. C. T. MALCOLMSON, electrical and mechanical engineer, is to be married at St. Louis, Mo., on Nov. 22 to Miss Margaret Ewing Wilkinson, daughter of Mr. and Mrs. John Cabell Wilkinson, of that city.

MR. CHARLES C. REMSEN, of the Sprague Electric Company, and Miss Mary Edna Fiske were married in St. Paul's Methodist Episcopal Church, Newark, N. J. Mr. and Mrs. Remsen have gone South on their wedding trip.

MR. OSCAR T. CROSBY'S fascinating book, "Tibet and Turkestan," has just been issued by G. P. Putnam's Sons, New York, and presents this well-known electrical engineer in his role of a brilliant and indefatigable explorer. The price is $2.50 net.

MR. JAMES R. CRAVATH, Western editor of the ELECTRICAL WORLD AND ENGINEER, lectured on "Illuminating Engineering" before the Chicago Architectural Club the evening of Oct. 30. The growing interest of architects in this subject is a hopeful feature of the work.

MR. W. E. DAVIS.—Advices from Sanford, Me., state that Mr. W. E. Davis, of Sanford, has been appointed electrical engineer of the Atlantic Shore Line Railway Company, and also the Alfred Light & Power Company, succeeding in the former position C. E. Sawyer, resigned. Mr. Davis still retains his connection with the Sanford Mills.

MR. ALFRED E. BRADDELL, the well-known electrical engineer and electrical inspector for the Underwriters' Association of the Middle Department, Philadelphia, has resigned that position, and on December 1 will join the conduit department of the Sprague Electric Company in New York City. Mr. Braddell has a large circle of acquaintances in metropolitan and other electrical circles.

PROF. H. S. CARHART, of the University of Michigan, has just returned from Europe this week by the *Kroonland*. After attending the meeting of the British Association for the Advancement of Science in South Africa, he proceeded to Berlin and participated in the conference on standards, etc., at the Reichsanstalt. He is now visiting the Bureau of Standards at Washington in connection with this work.

MR. H. D. ENDERISS has associated himself with Mr. Louis J. Costa, 1229 Real Estate Trust Building, Philadelphia. The latter, it will be remembered, has for some time represented the Jandus Electric Company, the Chase-Shawmut Company, and several other concerns in eastern Pennsylvania and surrounding States. To this list has just been added the Keystone Electrical Instrument Company.

MR. ALEX P. BROWNE, 31 State Street, Boston, Mass., has associated Mr. George K. Woodworth with him in the practice of patent law, to which Mr. Browne has devoted his attention for thirty years. Mr. Woodworth, who is an E. E. and M. E. of Cornell, has had experience for six years past as an examiner in the U. S. Patent Office, including more than four years in the electrical divison. He will give special attention to the electrical work of the firm.

MR. C. W. KELLOGG.—Mr. C. W. Kellogg, who has had charge of the Brockton plant of the Edison Electric Illuminating Company, succeeding Mr. Preston Player, who was promoted 15 months ago to the Blue Hill station, has been notified that Stone & Webster propose to transfer him to their plant in El Paso, Tex. There he will have charge of the station which furnishes light for the city, and power for the trolley lines. Mr. A. F. Nelson will succeed him in charge, and the Brockton and Lowell plants will be combined, it is said, under the district management of Mr. N. T. Wilcox, of Lowell.

MR. C. H. HADDRELL, since the incorporation of the Barriett Electric Manufacturing Company, of Cincinnati, in July, 1905, has been general manager and chief engineer of that company, and has been engaged in the design of a line of variable-speed motors for machine tool work, and improving the constant-speed motors. Mr. Haddrell started on his engineering career with the New Zealand Government and was for a number of years in the State Locomotive Engineer's office, engaged in design and general engineering work; then he went to London and studied electricity under Prof. S. P. Thompson. In 1900 he became inspector in the works of Siemens Bros., and a year later joined the staff of the Johnson-Lundell Electric Traction Company, and was engaged in dynamo design and in traction work. In the latter part of 1902 he came to the United States and was employed in the mechanical engineering department of the Westinghouse Electric & Manufacturing Company, upon some of the largest machines. In 1904, he was engaged by the Bullock Electric Company as senior draftsman for alternating-current machines. He is an associate of the Institution of Electrical Engineers of Great Britain.

Trade Publications.

TEST OF STEAM TURBINE.—The General Electric Company, Schenectady, N. Y., has issued a pamphlet describing a test of a 2,000-kilowatt Curtis steam turbine, which was made by Sargent & Lundy on May 3, 1905.

MOTOR-DRIVEN LAUNDERER.—The latest issue of the *Pigeon Hole* describes an interesting application of the electric motor in the form of a laundry extractor direct-connected to a direct-current motor made by the Peerless Electric Company, Warren, Ohio.

MERCURY-ARC RECTIFIERS.—The paper descriptive of the General Electric mercury arc rectifiers, which was read by Mr. P. D. Wagoner before the National Electric Light Association at the recent Denver-Colorado Springs convention, has been reprinted as publication No. 3341 by the General Electric Company, Schenectady, N. Y.

BELT-DRIVEN ALTERNATORS.—Bulletin No. 358 of the National Electric Company, Milwaukee, Wis., gives a complete discussion of the constructional features of revolving-field type belt-driven alternating-current generators. These machines are built for one, two or three phases, in capacities ranging from 32.5 kw to 750 kw.

LIGHTING SPECIALTIES.—The Yost Electric Manufacturing Company, Toledo, Ohio, has issued illustrated leaflets dealing with "Fiberite" shades, double "Falcon" wrenches for fixture work and "Electrogrip" for attaching electric lamps to desks, benches, machines, etc. This device will fit any socket. It is made of spring steel wire and the jaws are covered with rubber.

M. TOWNSLEY & SONS, of 1082 Seventeenth Street, Minneapolis, issue a small pamphlet with regard to their copper cable lightning rod, in connection with the utilization of which they have a neat little thunderstorm apparatus to illustrate how the lightning stroke can be averted. Their product consists of a very heavy cable made of pure copper, which is handled through the hardware trade.

PARTY-LINE SYSTEMS.—The Dean Electric Company, Elyria, Ohio, has issued as bulletin No. 100 an article by W. W. Dean on "Harmonic Party-Line Systems," which first appeared in the *American Telephone Journal*. The bulletin is well illustrated, numerous views being given of commercial party-line systems. In addition to the matter contained in the article there is given a complete description of the Dean harmonic party-line system.

FLY-WHEEL EXPLOSIONS.—The Fidelity and Casualty Company, 97 Cedar St., New York, has issued as a supplement to its MONTHLY BULLETIN for August, 1905, a reprint of an article on "Fly-Wheel Explosions" by Mr. Wm. H. Boehm, which appeared in the June number of *Insurance Engineering*. Formulas are developed for determining the stress in fly-wheel rims, and a table is given for showing the safe working speed of cast-iron fly-wheels.

HYDRAULIC ACCUMULATORS.—Under this title the Watson-Stillman Company, New York, has issued a pamphlet describing and illustrating a variety of hydraulic accumulators manufactured by it. These machines absorb the excess of pump delivery above the momentary demand of the machine, and deliver it when the demand is above the normal. The different types of machines are illustrated and with each description is given a table of dimensions, code words, etc. Some general hydraulic engineering information is also presented.

YALE & TOWNE MANUFACTURING COMPANY, 9 Murray Street, New York City, have just issued a handsome pamphlet—coarse brown paper embossed cover and rubricated title page—devoted to their portable electric hoists. These are shown in detail and in actual service for 110 and 220-volt practice, as standard, and for other voltages to order. The motor-driven trolley, also shown, is built to travel on the lower flange of I-beam track, and is a very useful appliance around the mill or factory. It is also built to travel on the top of two parallel tracks. The illustrations of the devices are clear, in perspective and diagram.

ELECTRICAL INSTRUMENTS.—The Keystone Electrical Instrument Company, Philadelphia, Pa., has just issued catalogue No. XIII, dealing with direct-current measuring instruments. These instruments are constructed on the principle of the Deprez-d'Arsonval galvanometer. They are equipped with permanent magnets having soft-steel pole pieces between which moves a light coil which carries the current to be measured. The catalogue is well illustrated, numerous views being given of the internal mechanism of the instruments. The company has also issued a pamphlet on the patent situation with reference to electrical instruments, in which it states that it has successfully defended every suit brought to final hearing against it, and that no court has, at final hearing, ever decreed any Keystone instrument to be an infringement of any patent.

HOLOPHANE DATA.—The Holophane Glass Company, sales department, 227 Fulton Street, New York, has just sent out a new loose-leaf publication entitled "Engineering Data and Catalog of the Holophane System of Illumination, comprising Holophane Globes and Holophane Pagoda Reflectors," upon which a great amount of thought and money has been expended. It contains not only the usual material that goes into a catalogue of globes and reflectors, but gives in addition the photometric curves, showing the distribution of light with nearly all the various types of Holophane globes and Pagoda reflectors. These data are of the greatest value to the illuminating engineer in planning installations using Holophane material. In fact, it is necessary that he should have such information before he can plan intelligently, although in the past in many cases it has not been obtainable. The tests shown were all made by the Electrical Testing Laboratories of New York, and hence are from an entirely unbiased source, and furthermore a source that is splendidly equipped, both by apparatus and experience to make such tests. The catalogue is handsomely bound in a morocco leather cover, pocket size, and being on the loose-leaf system, additional leaves can be added from time to time and obsolete ones discarded. The company has spent a large amount of money in getting up the catalogue in this form and in having tests made in the belief that by placing exact engineering information of this kind before possible customers its interest can be furthered better than in any other way.

News of the Trade.

GILLINDER & SONS, INC., 135 Oxford Street, Philadelphia, are pushing their "Q" arc light globes which are of medium weight and well adapted for their purpose.

AMERICAN ELECTRIC SIGN COMPANY, 133 Summer Street, Boston, Mass., has just removed to 44 High Street, and will have larger facilities there for the production of its specialties.

WETTENGEL BROS., 6122 Kirkwood Street, Pittsburg, Pa., have entered the electric lighting and supply business and would be pleased to receive catalogues, price lists and discount sheets of electric lighting and wiring materials.

ELECTRIC HEATERS.—The American Electrical Heater Company, of Detroit, has removed its New York headquarter offices and salesrooms from 35 Dey Street to 7 and 9 Warren Street, where Mr. B. H. Scranton, the president, directs operations personally.

THE WILLIAMS GAUGE COMPANY has opened an office at 311 Hennen Building, New Orleans, La. It is conducted by Mr. Charles L. Smith. Any inquiries for the Williams feed water regulator, steam trap and pump governor directed to Mr. Smith will receive his prompt and careful attention.

HIGH VOLTAGE POWER APPARATUS.—The Gregory Electric Company is offering a large lot of high voltage power transmission apparatus at attractive prices. It has just dismantled the entire plant of the Navaho Gold Mining Company, Bland, New Mexico. The plant consisted of 17,000 volt transmission equipment, including the step-up transformers, and all the supplies and motors going with the same.

THE NATIONAL ELECTRIC COMPANY, of Milwaukee, manufacturer of Christensen air brakes, air compressors and electrical machinery, has opened a Cleveland office at 416 Electric Building, in charge of Mr. George S. Hastings, who will handle the complete line throughout Ohio, Indiana, Michigan, West Virginia and New York as far east as Schenectady, and electrical machinery only in Pennsylvania as far east as Johnstown.

THE ELECTRO-DYNAMIC COMPANY, of New York, is preparing an interesting exhibit for the New York Electrical Show, to be held Dec. 12 to 23. One of the features of this exhibit will be an Inter-Pole motor driving another as a generator, the current to be used in the electric illumination of their booth. Another feature of the exhibit will consist in a display of the different sizes of frames showing how small and light the Inter-Pole motor is in proportion to its power. The ball bearings, which add so much to the efficiency of this type of motor will be another feature of the exhibit. This exhibit will also include demonstrations of the Moloney transformers, to show very high efficiency and low iron and idle load loss.

THE WILLIAMS GAUGE COMPANY has reported the sale, within the last six months, of 520,000-hp safety feed water regulators. Among the purchasers are the Philadelphia Rapid Transit Company, Illinois Central Railroad, New York Central and Hudson River Railroad, Delaware & Hudson Company, the Erie Railroad, Proctor & Gamble, Carnegie Steel Company, American Steel & Wire Company, etc. The demand for this regulator is increasing. The claims made for it by the company are that it will effect a fuel economy of from 4 to 12 per cent, a guaranteed assurance of dry steam constantly, and increased boiler efficiency. It is used on about 3,500,000 hp in the largest plants in the country, and has been on the market for upwards of seven years. This company also manufactures a steam operated trap, which it claims is the only trap with a valve which gives a full pipe opening instantly.

CORRECTIONS.—Due to an error by the printer in placing the type for pages 692 and 694 of our issue for October 21, three lines which should have appeared at the bottom of the second column on page 692 were transposed to the bottom of the second column on page 694. What should have been the second line of the sixth paragraph on page 694 was lifted out entirely. The first sentence of this paragraph should read as follows: "The controlling switch employed for this type of motor effects various combinations of the field and armature circuits of the separate motors, and of both motors, in series and parallel across the battery." As our readers are probably aware, under the modern system of machine typsetting, a correction anywhere in a line involves the removal of the whole line; and careless men in the printing office in changing the lines, after the editors have read the galley or page proofs, sometimes play all kinds of funny and exasperating tricks with the lines of type, which they omit or insert in wrong places.

NATIONAL METER COMPANY.—The exhibit of the National Meter Company, of 84 Chambers Street, New York, at the Madison Square Garden electrical show, to be held from Dec. 12 to 23, will be principally devoted to the exploitation of the uses of its gas engines for operating on producer gas or gasoline. The main exhibit for this purpose will consist of a 50-hp multiple-cylinder, direct-connected Nash gas engine of the self-oiling enclosed type, direct-connected to a 30-kw C & C generator. This engine will supply current to 560 16-cp electric lamps, of which the signs for this company's space will be composed. The practical purpose of this exhibit is to demonstrate to electrical and construction engineers particularly the value of devices of this character in carrying late night or peak loads while operating on producer gas. This engine insures a very close regulation of the lights—as constant, so the company states, as central station lighting, even under variable loads. That this equipment may be economically operated is indicated by a plant in St. Joseph, Mich., which is furnishing 125 arc lamps, extending over 4½ miles of streets, at the rate of one horse-power per hour for less than a pound of coal.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 31, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

802,993. TROLLEY WHEEL BEARING; Robert Kissinger, Columbus, O. App. filed Mar. 27, 1905. The trolley wheel has a split bushing, the parts of which are spring pressed apart so as to bear constantly against the trolley wheel and make efficient contact therewith.

802,994. TERMINAL CONNECTOR FOR ELECTRIC CONDUCTORS; John H. Kliegl and Anton T. Kliegl, New York, N. Y. App. filed Dec. 8, 1904. A terminal for insulated conductors formed of a T-shaped metal plate of which the wings are bent together in a die press so as to envelope and contact with the conductor.

802,999. FUSE-BLOCK OR CUT-OUT; Harry W. Lawrence, Denver, Colo. App. filed Apr. 30, 1904. A porcelain or other insulating box having a central partition and a cover which is capable of an interlocking engagement with the box. The sides of the box are cut away to permit ready access and the cover has projecting wings to close such cut-away portions when it is in position.

803,010. INSULATOR; Elmer P. Morris, East Orange, N. J. App. filed June 6, 1904. A method of supporting high potential wires so as to avoid crippling the system when the wooden supporting arms burn off and allow wires to fall. Ribbed insulating plates are provided upon which the wires may rest under these circumstances.

803,020. CONTROLLER FOR ELECTRIC CARS; Francis A. Roche and Francis J. Roche, Somerville, Mass. App. filed Mar. 15, 1905. A construction of controller which shall prevent a too rapid initial movement of the handle, but which shall permit back and forth intermediate movements freely. Steel balls are contained in an annular recess which cooperate with lugs to produce the desired effect.

803,107. TRANSMISSION OF ELECTRIC CURRENTS; Isidor Kitsee, Philadelphia, Pa. App. filed May 20, 1904.

803,108. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed June 24, 1904.

803,109. TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY; Isidor Kitsee, Philadelphia, Pa. App. filed Sept. 17, 1904.

803,110. TRANSMISSION OF ELECTRIC CURRENTS; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 28, 1904.

803,111. TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY; Isidor Kitsee, Philadelphia, Pa. App. filed Mar. 25, 1905.

803,112. TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY; Isidor Kitsee, Philadelphia, Pa. App. filed April 10, 1905.

803,120. CONDUIT SECTION FOR MANHOLE TERMINALS; Robert W. Lyle, New York, N. Y. App. filed Jan. 13, 1903. A terminal for telephone conduits having a pair of hopper-shaped boxes which are designed to be embedded in the masonry of the manholes.

803,136. ELECTRIC SWITCH; John J. Ruddick, Newton, Mass. App. filed Nov. 27, 1903. At the entrance to a block section a box is placed on the trolley wire which has a pair of tappets or contactors extending into proximity with the trolley wheel. These are effective to step around a pair of ratchet wheels for making the signal circuits.

803,147. ELECTRIC FURNACE; Edwin Appleby, Chicago, Ill. App. filed January 28, 1905.

803,180. MEANS FOR PRODUCING HIGH POTENTIAL ELECTRICAL DISCHARGES; Oliver Joseph Lodge, Birmingham, England. App. filed Oct. 10, 1904. (See Current News and Notes).

803,199. SPACE TELEPHONY; John Stone Stone, Cambridge, Mass. App. filed June 20, 1905. (See page 825.)

803,208. TROLLEY CATCHER; Warren W. Annable, Grand Rapids, Mich. App. filed Mar. 31, 1905. A retrieving apparatus for trolleys involving a sliding carriage upon the trolley pole. The cord makes a turn around this carriage which in the case of a quick movement binds upon the trolley pole and prevents the latter from rising.

803,209. CONTROL SYSTEM FOR ELECTRIC MOTORS; Ralph E. Bates, Wilkinsburg, Pa. App. filed Feb. 1, 1905. A system for steering boats involving a series of segments with which an arm upon the rudder contacts, and a steering wheel, also having segments which make contacts to operate an electric motor until a follower arm has come into a position corresponding to the rudder of the boat.

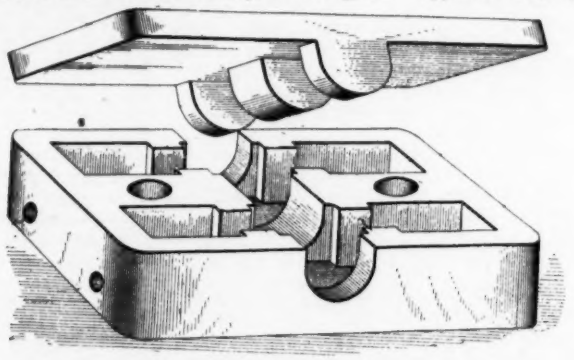
803,210. TROLLEY RETRIEVING DEVICE; Henry B. Clarke, Chicago, Ill. App. filed Jan. 16, 1905. A trolley retriever in which the rope passes over a pivoted arm which controls an air valve. A suddent movement admits air against a diaphragm which releases a spring drum to retrieve the trolley.

803,212. SWITCH FOR ELECTRIC CIRCUITS; Frank Conrad, Edgewood Park and Arthur B. Reynders, Wilkinsburg, Pa. App. filed Nov. 21, 1903. A switch for heavy currents in which the final movement of the knife blade lever engages a cam surface which expands the knife blade endwise into wedging contact with the terminal plates.

803,213. ALTERNATING-CURRENT SYSTEM OF CONTROL; Frank Conrad, Edgewood Park, Pa. App. filed Apr. 3, 1905. A system for equalizing the potential on alternating-current railway motors involving a couple of regulator motors and an intermediate transformer. When a difference of potential occurs the transformer becomes effective to assist one regulator and oppose the other, so that their speed varies and equalizes the potential of the main motors.

803,214. CONTROLLING SYSTEM FOR RAILWAY VEHICLES AND TRAINS; John L. Crouse, New York, N. Y. App. filed Jan. 22, 1903. A system for operating the emergency brakes in case a motorman falls asleep or becomes disabled. The controller arm has a tappet thereon which operates a switch for stopping the motor and applying the emergency brake, when the controller arm is released, unless a button is maintained depressed by the motorman.

803,215. OVERHEAD STRUCTURE FOR ELECTRIC RAILWAYS; Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Oct. 19, 1904.



802,999.—Fuse-Block or Cut-Out.

A mechanical arrangement for connecting insulated trolley wire sections employing a wooden strip or board with fixtures secured to each end for the attachment of the trolley wires. The board is sustained at both ends from insulators.

803,216.—SUSPENSION DEVICE FOR TROLLEY CONDUCTORS; Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Jan. 17, 1905. A trolley wire is suspended in absolutely rectilinear relation by a pair of messenger cables with V-shaped fixtures depending therefrom by which the trolley wire is clasped.

803,233. ELECTRIC CONTROL SYSTEM; Henry D. James, Pittsburg, Pa. App. filed Apr. 3, 1905. Provides means by which all changes and connections from the transformer to the controlling device in an alternating-current system, are accomplished when no current flows through the circuits that are in use.

803,237. ELECTRIC RELAY; Isidor Kitsee, Philadelphia, Pa. App. filed May 3, 1905.

803,245. PLUG OR CONNECTION FOR ELECTRIC LIGHT LINE WIRES; Charles P. Parnell, New York, N. Y. App. filed Apr. 19, 1904. A pair of plugs each having a threaded shell, which are engaged with an intermediate threaded connecting member also constituting a fuse plug.

803,246. ELECTRIC LAMP SOCKET; Charles P. Parnell, New York, N. Y. App. filed May 18, 1904. Especially designed for marine and railroad work where the vibration is liable to loosen the ordinary form. The usual stud on the lamp has cavities in which a spring pressed toothed plate engage to hold the lamp against rotation.

803,252. TROLLEY FOR ELECTRICALLY PROPELLED VEHICLES; Normal W. Storer, Pittsburg, Pa. App. filed Feb. 15, 1905. Specially applicable to high-speed railways in which the ordinary trolley wheel cannot be used. A horizontal plate is supported to slidably contact with the wire and has grooves to contain a lubricant.

803,253. ELECTRIC REGULATOR OR CONTROLLER; Harve R. Stuart, Wilkinsburg, Pa. App. filed Sept. 26, 1903. A form of regulating transformer having a helical primary winding which is rotated spirally against the contact so as to gradually cut out the wire. The apparatus is used successively to cut out the main transformer windings step by step.

803,254. METHOD OF REGULATING ALTERNATING-CURRENT ELECTROMOTIVE FORCE; Harvey R. Stuart, Wilkinsburg, Pa. App. filed Sept. 26, 1903. Claims the method of the above described apparatus.

803,263. ELECTROLYTIC CELL; Henry S. Anderson, El Paso, Texas. App. filed June 21, 1905.

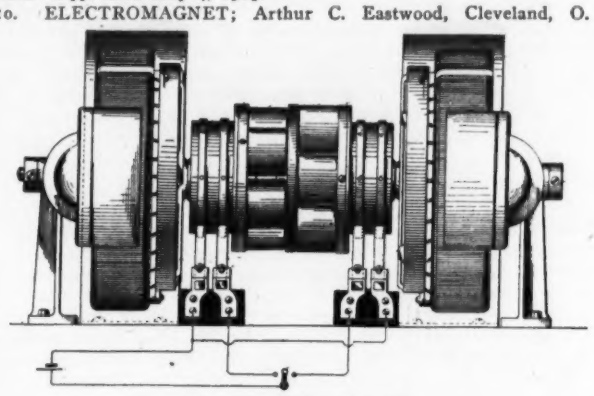
803,322. MOTOR ACTUATOR; Daniel Bacon, New York, N. Y. App. filed Feb. 25, 1905. A pair of motor armatures are rotated continuously in opposite directions, and carry magnets which can be energized to carry around an iron disk. The circuits of such magnets can be manipulated at will so that the disk can be rotated in either direction as desired.

803,365. ELECTRIC RAILWAY; Maurice C. Rypinski, Schenectady, N. Y. App. filed Mar. 31, 1902. Four-toothed gears are placed at intervals along the track so as to be rotated one tooth by a tappet on a passing train. If a following train passes the gear prematurely, the latter will be rotated another notch or tooth, which will throw a main switch and stop the train.

803,378. CONTROL OF ELECTRIC ELEVATORS; George A. P. Weymouth, Melbourne, Victoria, Australia. App. filed Apr. 3, 1905. At each floor fingers are supported which are moved to alternate positions by the passage of the car. These serve to control the direction of the elevator motor so that the closing of a switch at any floor will always propel the car in the right direction.

803,403. LONG-DISTANCE ELECTRIC CIRCUIT; Mark S. Lewis, Medford, Mass. App. filed May 4, 1905.

803,410. ELECTROMAGNET; Arthur C. Eastwood, Cleveland, O. App.



803,322.—Motor Actuator.

filed Apr. 1, 1904. At each end of the magnet coil iron heads are provided which have openings closely surrounding the core. These exert a magnetic damping effect and arrest the oscillations of the core.

803,414.—REMOTE CONTROL REGULATOR; John L. Hall and William C. Yates, Schenectady, N. Y. App. filed Mar. 20, 1905. The rheostat arm may be propelled in either direction by oppositely directed ratchet pawls upon the same lever which are respectively made effective by the action of one or another operating magnet.

803,423. ELECTRIC LAMP SOCKET; Normal Marchall, Newton, Mass. App. filed Dec. 24, 1900. A Z-shaped strip is fastened to one side of a porcelain base so as to project centrally thereof and constitute the central contact member of the lamp socket.

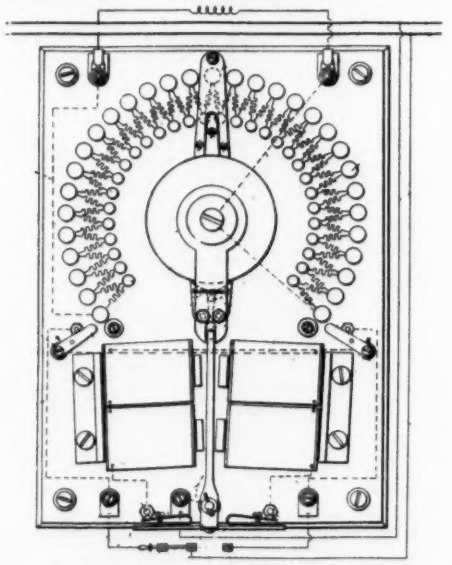
803,442. APPARATUS FOR SHORT-CIRCUITING TURNS IN ARMATURE COILS; John F. Shoemaker, Madison, Wis. App. filed Apr. 13, 1905. An apparatus for short circuiting the rotor of an induction motor after it attains speed, comprising a plate having a circumferential row of knife blade switches and an additional plate movable in parallel relation thereto for closing said switches when desired.

803,451. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 1, 1904. The resistance elements are wound upon parallel spools and a spiral blade swings between said elements so as to contact with different turns progressively, first on one spool and then on the other.

803,452. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 12, 1904. A modified form of the above in which the coils are wound upon parallel cores as before and a blade swings in a plane tangential of the windings so as to successively cut in or out successive turns.

803,453. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 12, 1904. A fixed resistance embodying a frame from which depend two rods upon which are wound the resistance elements.

803,462. ALTERNATING CURRENT MOTOR CONTROL; Charles E. Barry, Schenectady, N. Y. App. filed June 24, 1904. Supplies the motors from two independent sources of current, such as the secondaries of two



803,414.—Remote Control Regulator.

transformers and provides a switch adapted to connect these secondaries in parallel and in series so as to vary the potential impressed upon the motor circuit.

803,486. MAGNETICALLY OPERATED SWITCH; George H. Hill, Schnectady, N. Y. App. filed June 13, 1904. A construction of conductor in which the operating magnet has a stem with blades thereon which switch the operating current on to the next contactor. The main circuit is broken between the curved blades adjacent to the pole of the blow-out magnet so as to eliminate the arc.

803,502. RAILWAY SIGNAL SYSTEM; James C. Mock, Detroit, Mich. App. filed Jan. 11, 1904. A system of railroad signals adapted for switch crossings employing a spring blade adjacent to the usual rails with which the wheels make contact in passing. The plate is insulated from the rails.

803,513. SPACE TELEPHONY; John Stone Stone, Cambridge, Mass. App. filed June 29, 1905. (See page 825.)

802,981. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed Dec. 10, 1902. (See Current News and Notes.)

812,394. CONTROLLER; John P. Durkin, Philadelphia, Pa. App. filed Sept. 21, 1905. The usual controller arm has a pawl which may be thrown outward by centrifugal force. If the motion of the controller arm is too rapid, the pawl catches on notches, but immediately drops back so as to permit further movement of the controller arm.